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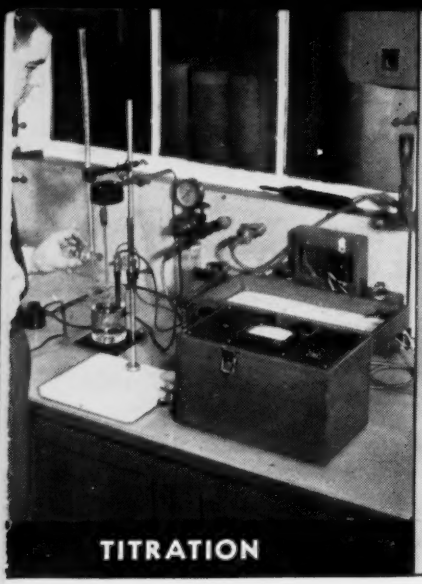

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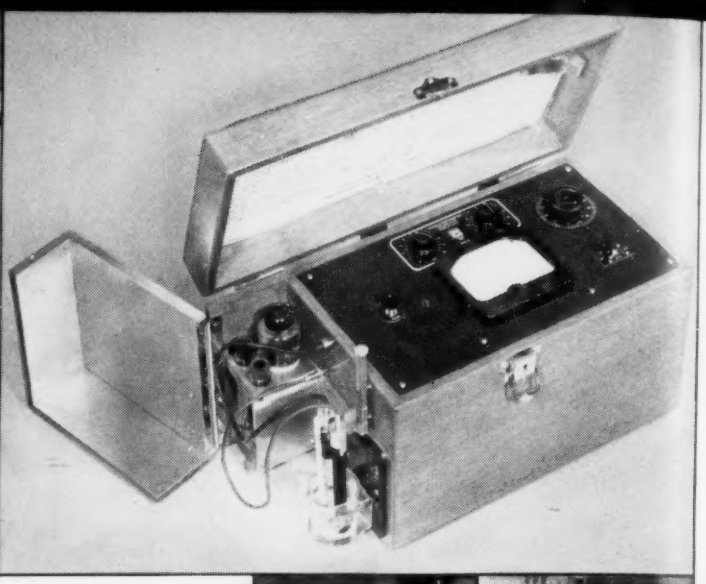

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THE SCIENTIFIC MONTHLY

OCTOBER 1946

RUNNING A PROFESSIONAL SOCIETY, OR THE HAPPY LIFE OF AN EXECUTIVE SECRETARY

By HENRY CLEPPER
SOCIETY OF AMERICAN FORESTERS, WASHINGTON

PROFESSIONAL societies in America have as many manifestations as a Hindu goddess.

They are numbered by the hundreds, and most professional workers belong to at least one. Casually ask a professional man why he is a member of his society, and he will probably murmur vaguely something about keeping abreast of developments in his field. Given more time to think about it, he may add that he belongs because it is the organization which represents his profession; that, while he doesn't get many direct benefits from it, on the whole it's a good thing; and, in short, he's been a member for years, likes to attend the meetings and read the journal when he's not too busy. He's often pretty busy.

Invariably, a description of a professional society in a directory or yearbook is written in cold and unemotional prose. Its stated objectives usually are "to advance scientific and educational development . . . to promote the technical practice . . . and to maintain high standards" of something or other, etc. Now these are necessary and desirable objectives in any endeavor, as every right-thinking person will agree. But in reading such a description, one would never suspect that the organization is composed of warm human beings who, for all their scientific training and specialized technical knowledge, enjoy drinking a cocktail, casting a fly rod, or relaxing with a "whodunit."

A certain United States senator, an unconscious and persistent bumbler, once remarked apropos the human side, "It is my observation, sir, that one individual has as much human nature as the next man—if not more so." Thus it is with professional societies and the hired help, the executive secretaries who run them. The human element is highly important.

Thoreau in one of his bitter moods (he was often bitter) complained, "Our life is frittered away by detail." I cannot think of any class of worker whose lives are more likely to be frittered away by detail than secretaries of professional societies—if they permit it. During a single day a secretary may be expected to display the sympathetic understanding of a father confessor, the diplomacy of an embassy attaché, the business acumen of a wholesale merchant, the salesmanship of a used-car dealer, the financial judgment of a stockbroker, and the information of a radio quiz expert. In between times he dictates letters, signs checks, reads manuscripts, writes

reports, talks to callers, keeps appointments, answers questions, gives advice, receives advice, laughs at funny and unfunny stories, shakes hands—and loves it. Often his really productive work may be done after office hours, usually at home.

Edward Gibbon once wrote that "whatsoever may be the fame of learning or genius, experience has shown me that the cheaper qualifications of politeness and good sense are more useful currency in the commerce of life." Assuming that a professional man has adequate scientific training and technical experience in his field, I would rate as his foremost qualifications for success as secretary of a professional society Gibbon's dictum regarding politeness and good sense. But I would add two others, sincerity and enthusiasm. And a sense of humor helps. Oh, how it helps!

Still another most important endowment for success—and happiness—as an executive secretary is a genuine liking for people. A story, doubtless apocryphal, is told of the late Clemenceau, Tiger of France. He is alleged to have said that he loved France but hated the French. If true, he would not have made a good executive secretary of a professional society. For a society is a body of persons, and an executive secretary must have the gregarious temperament that enjoys association with people.

Not only must he like people, he should be one of those fortunate individuals of whom it is always said with admiration, "Why, he can remember names as well as faces." Perhaps required experience for an executive secretary should be at least one year of employment as a room clerk in a large hotel. One is not born with an aptitude for remembering names and faces. It is learned the hard way.

Following a society meeting I spend many hours on trains cataloguing the members present and memorizing some salient characteristic of each so that I can, if lucky, identify him when next we meet. For example, I meet Brown for the first time in Maine. He smokes a curved-stem pipe, is working on the blister rust of white pine, and has an authentic New England accent. I file this information in my memory—the filing system, unfortunately, has many defects—and two years later our trails cross in Michigan. Something, as the saying goes, clicks. We shake hands, I call him by name, observe that he still fancies a curved stem whereas I adhere to a straight stem, ask about the blister rust project, and inquire about mutual friends in New England. Brown is charmed.

Don't misunderstand me. All this is not abracadabra merely to impress Brown. It has a more serious purpose. For he is a member of our society, his dues help pay the salaries of our staff, his membership along with thousands of others makes it possible to publish our professional journal. In short, I work for Brown. He doesn't think of me as his servant, but I do. But, alas, because there are several thousand Browns it is not possible to remember them all. One does one's best.

One more example. A prospective junior member writes for an appointment. Before he arrives I consult the yearbook of his school. I study his photograph, observe that he played varsity basketball, and was born in California. When he arrives we have subjects to start conversation, and he is humanly pleased that I am informed about him. In short, he is not merely a person; he is a personality.

I OFTEN wonder how many professional men and women who attend a meeting of their society realize the preparation that has gone into it. Even

after a program committee and a committee on local arrangements have been appointed, it is usually the executive secretary's responsibility to see to it that registration, printed programs, meeting rooms, banquet rooms, badges, tickets, secretarial help, press service, and all the other minutiae essential to the smooth functioning of a big meeting have been arranged.

A colleague, the executive secretary of an engineering society, once offered the suggestion that an essential qualification for his kind of job should be five years with Barnum and Bailey's circus. The analogy between a large professional meeting and a three-ring circus complete with side shows is not as far fetched as may appear.

Officers and members of professional societies like to maintain the polite fiction that no such thing as organization politics exists, as actually it does not in the opprobrious connotation of the term. But to deny that certain groups or individuals are not constantly active to promote special causes and policies, within the framework of the organization and through the use of the ballot, is unrealistic. Frequently, such causes are quite laudable, and the only obstacle to their acceptance is that a majority of the membership is opposed or indifferent. And here is where the executive secretary had better watch his step. If he fails to espouse the movement, he may be called a reactionary. If he goes all out for it, he may be dubbed radical. Even when he personally desires to do one or the other, he may do neither, not out of spinelessness, but simply in the interest of solidarity. Not to put too fine a point on it, the executive secretary is well advised to perform the function his title implies, that is, execute the policies of his officers and avoid championing causes and movements. If all this seems somewhat obscure to you, dear reader, *your* executive secretary will know what I mean.

To the extent that it is humanly possible, the executive secretary must be all things to all men. Like Ulysses, he must be a part of all that he has met.

Let's say he is invited to appear before a Congressional committee which is considering legislation of interest to his society. He must make his presentation in a confident manner which will artfully convey an impression of omnipotence combined with a subtle suggestion of respect for the profundity of the committee. If his statement is long he is wise to confine his oral presentation to ten minutes or less and request permission to include the longer version in the record. Such permission is rarely withheld. He will know every committee member by name, and if questioned his answers will be courteous, concise, and complete.

Your executive secretary must be ready on a moment's notice to respond to a toastmaster's request for a few remarks. To be truthful, I have never quite understood exactly what is meant by "a few remarks." But, like the preacher with a grace, a prayer, or a sermon always on tap, a secretary should have a repertoire of five-, ten-, fifteen-, twenty-, and thirty-minute "remarks" always available and suitable to the occasion. On the rounds of his appointed tasks he will as a matter of course attend numerous functions of which a luncheon or dinner is usually a part. I have been solemnly assured by a presiding officer as we entered a dinner meeting that there positively would be no speeches, only to have him rise an hour later, when everyone present was partly stupified with food, coffee, and cigars, and blandly call on me for "a few remarks." If Dante were writing today he would invent a special hell for such people. But I digress.

With his many miscellaneous and diverse activities as well as routine duties, one might assume that the executive secretary would have little time to keep up with current literature in his field and would be pardoned if he didn't. Not so. Even if his natural curiosity about new scientific developments and techniques is not sufficient to maintain his interest in professional journals and books, he had better have at least a speaking knowledge of "what's cookin'" in the major fields of specialization else the research and professorial elements in the society may tag him as "a nice chap but superficial." One may be damned with fainter praise than this, but few labels are harder to live down.

To summarize, the executive secretary of a professional society should possess the following native endowments and acquired abilities:

1. Adequate technical training in his field.
2. Tact, mature judgment, sincerity, and enthusiasm.
3. The temperament gregarious, combined with love of his fellow-men.
4. A sense of humor.
5. A conviction of the value of his profession to human progress.
6. Ability to remember names and faces, especially of dues-paying members in good standing.
7. Ability to represent his profession competently and favorably before the public.
8. Adroitness in avoiding extraneous issues and determination to stick to the main job.
9. A readiness to submerge his personality for the good of the cause.
10. A belief and pride in the nobility of service.

In short, Superman!

ATOMIC POWER

Before recorded history began
Prometheus, symbol of Science, brought us fire,
The altar and the hearth were our desire;
On these were built the faith and hope of man.
Then wood and stone and bronze and steel and steam
In turn became the servants of our will;
Knowledge we got and with it thought to fill

Each need and want, to realize each dream.
Again Prometheus brings a magic gift,
Which scarce we know if we should ban or bless.
The boldest hesitate, the fearful cower,
Before this weapon, deadly, sure and swift.
Amazed we stand, appalled at our success;
For who are we to wield this cosmic power?

THOMSON KING

THE MOTIONLESS ARROW

By N. A COURT

DEPARTMENT OF MATHEMATICS AND ASTRONOMY, UNIVERSITY OF OKLAHOMA

IN THE lore of mankind the arrow occupies a conspicuous place, a place of distinction. There is the heroic arrow with which the legendary William Tell, at the behest of a tyrant, shot an apple off his own son's head, to say nothing of the other arrow that Tell held in reserve for the tyrant himself, in case his first aim should prove too low. There is the soaring first arrow of Hiawatha that would not touch the ground before the tenth was up in the air. There is the universally famous romantic arrow with which Cupid pierces the hearts of his favorites—or shall I say victims?

There is also an arrow that is philosophical, or scientific, or, better still, both. This famous "motionless arrow," as it may best be called, has stirred the mind, excited the imagination, and sharpened the wits of profound thinkers and erudite scholars for well over two thousand years.

Zeno of Elea, who flourished in the fifth century B.C., confronted his fellow philosophers and anybody else who was willing to listen with the bold assertion that an arrow, the swiftest object known to his contemporaries, cannot move at all.

According to Aristotle, Zeno's argument for, or proof of, his embarrassing proposition ran as follows: "Everything, when in uniform state, is continually either at rest or in motion, and a body moving in space is continually in the Now [instant], hence the arrow in flight is at rest." Some six centuries later another Greek philosopher offered a somewhat clearer formulation of the argument: "That which moves can neither move in the place where it is, nor yet in the place where it is not." Therefore, motion is impossible.

The "motionless arrow" was not Zeno's only argument of its kind. He had others. Zeno had Achilles engage in a race with a tortoise and showed a priori that the "light-of-foot" Achilles could never overtake the proverbially slow turtle. In Aristotle's presentation, here is the argument: "In a race the faster cannot overtake the slower, for the pursuer must always first arrive at the point from which the one pursued has just departed, so that the slower is always a small distance ahead." A modern philosopher states the argument more explicitly: "Achilles must first reach the place from which the tortoise has started. By that time the tortoise will have got on a little way. Achilles must then traverse that, and still the tortoise will be ahead. He is always nearer, but he never makes up to it."

A third argument of Zeno's against motion is known as the "Dichotomy." In Aristotle's words: "A thing moving in space must arrive at the mid-point before it reaches the end-point." J. Burnet offers a more elaborate presentation of this argument:

> You cannot traverse an infinite number of points in a finite time. You must traverse half a given distance before you traverse the whole, and half of that again before you traverse it. This goes on ad infinitum, so that (if space is made up of points) there are an infinite number in any given space, and it cannot be traversed in a finite time.

Zeno had still other arguments of this kind. But I shall refrain from quoting them, for by now a goodly number of you have no doubt already begun to wonder what this is all about, what it is

supposed to mean, if anything, and how seriously it is to be taken. Your incredulity, your skepticism, reflect the intellectual climate in which you were brought up and in which you continue to live. But that climate has not always been the same. It has changed more than once since the days of Zeno.

To take a simple example. We teach our children in our schools that the earth is round, that it rotates about its axis, and also that it revolves around the sun. These ideas are an integral part of our intellectual equipment, and it seems to us impossible to get along without them, much less to doubt them. And yet when Copernicus, or Mikołaj Kopernik, as the Poles call him, published his epoch-making work barely four centuries ago, in 1543, the book was banned as sinful. Half a century later, in 1600, Giordano Bruno was burned at the stake in a public place in Rome for adhering to the Copernican theory and other heresies. Galileo, one of the founders of modern science, for professing the same theories, was in jail not much more than three centuries ago.

WHAT Zeno himself thought of his arguments, for what reason he advanced them, what purpose he wanted to achieve by them, cannot be told with any degree of certainty. The data concerning his life are scant and unreliable. None of his writings are extant. Like the title characters of some modern novels such as *Rebecca,* by Daphne du Maurier, or *Mr. Skeffington,* by Elizabeth Arnim Russell, Zeno is known only by what is told of him by others, chiefly his critics and detractors. The exact meaning of his arguments is not always certain.

Zeno may or may not have been misinterpreted. But he certainly has not been neglected. Some writers even paid him the highest possible compliment—they tried to imitate him. Thus the "Dichotomy" suggested to Giuseppe Biancani, of Bologna, in 1615 a "proof" that no two lines can have a common measure. For the common measure, before it could be applied to the whole line, must first be applied to half the line and so on. Thus the measure cannot be applied to either line, which proves that two lines are always incommensurable.

A fellow Greek, Sextus Empiricus, of the third century A.D., taking the "motionless arrow" for his model, argued that a man can never die, for if a man die, it must be either at a time when he is alive or when he is dead, etc.

It may be of interest to mention in this connection that the Chinese philosopher Hui Tzu argued that a motherless colt never had a mother. When it had a mother it was not motherless and at every other moment of its life it had no mother.

Some writers offered very elaborate interpretations of Zeno's arguments. These writers saw in the creator of these arguments a man of profound philosophical insight and a logician of the first magnitude. Such was the attitude of Immanuel Kant and, a century later, of the French mathematician Jules Tannery. To Aristotle, who was born about a century after Zeno, these arguments were just annoying sophisms whose hidden fallacy it was all the more necessary to expose in view of the plausible logical form in which they were clothed. Other writers displayed just as much zeal in showing that Zeno's arguments are irrefutable.

Aristotle's fundamental assumptions are that both time and space are continuous, that is, "always divisible into divisible parts." He further adds: "The continual bisection of a quantity is unlimited, so that the unlimited exists potentially, but it is never reached."

With regard to the "Arrow" he says:

> A thing is at rest when it is unchanged in the Now and still in another Now, itself as well as its parts remaining in the same status. . . . There is no motion, nor rest in the Now. . . . In

a time interval, on the contrary, it [a variable] cannot exist in the same state of rest, for otherwise it would follow that the thing in motion is at rest.

That it is impossible to traverse an unlimited number of half-distances (the "Dichotomy"), Aristotle refutes by pointing out that "time has unlimitedly many parts, in consequence of which there is no absurdity in the consideration that in an unlimited number of time intervals one passes over unlimited many spaces."

The argument Aristotle directs against "Achilles" is as follows:

If time is continuous, so is distance, for in half the time a thing passes over half the distance, and, in general, in the smaller time the smaller distance, for time and distance have the same divisions, and if one of the two is unlimited, so is the other. For that reason the argument of Zeno assumes an untruth, that one unlimited cannot travel over another unlimited along its own parts, or touch such an unlimited, in a finite time; for length as well as time and, in general, everything continuous, may be considered unlimited in a double sense, namely according to the [number of] divisions or according to the [distances between the] outermost ends.

Aristotle seems to insist that as the distances between Achilles and the tortoise keep on diminishing, the intervals of time necessary to cover these distances also diminish, and in the same proportion.

The reasonings of Aristotle cut no ice whatever with the French philosopher Pierre Bayle, who in 1696 published his *Dictionnaire Historique et Critique*, translated into English in 1710. Bayle goes into a detailed discussion of Zeno's arguments and is entirely on the side of Zeno. He categorically rejects the infinite divisibility of time.

Successive duration of things is composed of moments, properly so called, each of which is simple and indivisible, perfectly distinct from time past and future and contains no more than the present time. Those who deny this consequence must be given up to their stupidity, or their want of sincerity, or to the unsurmountable power of their prejudices.

Thus the "Arrow" will never budge.

The philosophical discussion of the divisibility or the nondivisibility of time and space continues through the centuries. As late as the close of the past century Zeno's arguments based on this ground were the topic of a very animated discussion in the philosophical journals of France.

A MATHEMATICAL approach to "Achilles" is due to Gregory St. Vincent, who in 1647 considered a segment AK on which he constructed an unlimited number of points B, C, D, . . . such that $AB/AK = BC/BK = CD/CK = \ldots = r$, where r is the ratio, say, of the speed of the tortoise to the speed of Achilles. He thus obtains the infinite geometric progression $AB + BC + CD + \ldots$, and, since this series is convergent, Achilles does overtake the elusive tortoise.

Descartes solved the "Achilles" by the use of the geometric progression $1/10 + 1/100 + 1/1000 + \ldots = 1/9$. Later writers quoted this device or rediscovered it time and again. But this solution of the problem raised brand-new questions.

St. Vincent overlooked the important fact that Achilles will fail to overtake the slow-moving tortoise after all, unless the variable sum of the geometric progression actually reaches its limit. Now: Does a variable reach its limit, or does it not? The question transcends, by far, the "Achilles." It was, for instance, hotly debated in connection with the then nascent differential and integral calculus. Newton believed that his variables reached their limits. Diderot, writing a century or so later in the famous *Encyclopédie*, is quite definite that a variable cannot do that, and so is De Morgan, in the *Penny Cyclopedia* in 1846. Carnot and Cauchy, like Newton, have no objections to variables reaching their limits.

The other question that arises in con-

nection with St. Vincent's progression is: How many terms does the progression have? The answer ordinarily given is that the number is infinite. This answer, however, may have two different meanings. We may mean to say that we can compute as many terms of this progression as we want and, no matter how many we have computed, we can still continue the process. Thus the number of terms of the progression is "potentially" infinite. On the other hand, we may imagine that all the terms have been calculated and are all there forming an infinite collection. That would make an "actual" infinite. Are there actually infinite collections in nature? Obviously, collections as large "as the stars of the heaven, and as the sand which is upon the seashore," are nevertheless finite collections.

From a quotation of Aristole already given it would seem that he did not believe in the actually infinite. Galileo, on the other hand, accepted the existence of actual infinity, although he saw clearly the difficulties involved. If the number of integers is not only potentially but actually infinite, then there are as many perfect squares as there are integers, since for every integer there is a perfect square and every perfect square has a square root. Galileo tried to console himself by saying that the difficulties are due to the fact that our finite mind cannot cope with the infinite. But De Morgan sees no point to this argument, for, even admitting the "finitude" of our mind, "it is not necessary to have a blue mind to conceive of a pair of blue eyes."

A younger contemporary of Galileo, the prominent English philosopher Thomas Hobbes (1588–1679), could not accept Galileo's actual infinity, on theological grounds. "Who thinks that the number of even integers is equal to the number of all integers is taking away eternity from the Creator." However, the very same theological reasons led a very illustrious younger contemporary of Hobbes, namely, Leibnitz, to the firm belief that actual infinities exist in nature *pour mieux marquer les perfections de son auteur.*

The actual infinite was erected into a body of doctrine by Georg Cantor (1845–1918) in his theory of transfinite numbers. The outstanding American historian of mathematics, Florian Cajori, considers that this doctrine of Cantor's provided a final and definite answer to Zeno's paradoxes and thus relegates them to the status of "problems of the past."

Tobias Danzig in his *Number, the Language of Science* is not quite so happy about it, in view of the fact that the whole theory of Cantor's is of doubtful solidity.

Whatever may have been the reasons that prompted Zeno to promulgate his paradoxes, he certainly must have been a man of courage if he dared to deny the existence of motion. We learn of motion and learn to appreciate it at a very, very early age; motion is firmly imbedded in our daily existence and becomes a basic element of our psychological make-up. It seems intolerable to us that we could be deprived of motion, even in a jest.

Nevertheless, the systematic study of motion is of fairly recent origin. The ancient world knew a good deal about Statics, as evidenced by the size and solidity of the structures that have survived to the present day. But they knew next to nothing about Dynamics, for the forms of motion with which they had any experience were of very narrow scope. Their machines were of the crudest and very limited in variety. Zeno's paradoxes of motion were for the Greek philosophers "purely academic" questions.

The astronomers were the first to make systematic observations of motion not due to muscular force and to make deductions from their observations. Man studied motion in the skies before he

busied himself with such studies on earth. How difficult it was for the ancients to dissociate motion from muscular effort is illustrated by the fact that Helios (the sun) was said by the Greeks to have a palace in the east whence he was drawn daily across the sky in a fiery chariot by four white horses to a palace in the west.

The famous experiments of Galileo with falling bodies are the beginning of modern Dynamics. The great voyages created a demand for reliable clocks, and the study of clock mechanisms and their motion engaged the attention of such outstanding scholars as Huygens. No small incentive for the study of motion was provided by the needs of the developing artillery. The gunners had to know the trajectories of their missiles. The theoretical studies of motion prompted by these and other technical developments were in need of a new mathematical tool to solve the newly arising problems, and calculus came into being.

The infinite, the infinitesimal, limits and other notions that were involved, perhaps crudely, in the discussion of Zeno's arguments were also involved in this new branch of mathematics. These notions were as hazy as they were essential. Both Newton and Leibnitz changed their views on these points during their lifetimes because of their own critical acumen as well as the searching criticism of their contemporaries. But neither of them ever entertained the idea of giving up their precious find, for the good and sufficient reason that this new and marvelous tool gave them the solution of some of the problems that had defied all the efforts of mathematicians of preceding generations. The succeeding century, the eighteenth, exploited to the utmost this new instrument in its application to the study of motion, and before the century was over it triumphantly presented to the learned world two monumental works: the *Mécanique Analytique* of Lagrange and the *Mécanique Céleste* of Laplace.

The development of Dynamics did not stop there. It kept pace with the phenomenal development of the experimental sciences in the nineteenth century. These theoretical studies on the one hand served as a basis for the creation of a technology that surpassed the wildest dreams of past generations and on the other hand changed radically our attitude toward many of the problems of the past; they created a new intellectual atmosphere, a new "intellectual climate."

Zeno's arguments, or paradoxes, if you prefer, deal with two questions which in the discussions of these paradoxes are very closely connected, not to say mixed up: What is motion, and how can motion be accounted for in a rational, intellectual way? By separating the two parts of the problem we may be able to come much closer to finding a satisfactory answer to the question, in accord with the present-day intellectual outlook.

The critical study of the foundations of mathematics during the nineteenth century made it abundantly clear that no science and, more generally, no intellectual discipline can define all the terms it uses without creating a vicious circle. To define a term means to reduce it to some more familiar component parts. Such a procedure obviously has a limit beyond which it cannot go. Most of us know what the color "red" is. We can discuss this color with each other; we can wonder how much the red color contributes to the beauty of a sunset; we can make use of this common knowledge of the red color for a common purpose, such as directing traffic. But we cannot undertake to explain what the red color is to a person born color blind.

In the science of Dynamics motion is such a term, such an "undefined" term, to use the technical expression for it. Dynamics does not propose to explain

what motion is to anyone who does not know that already. Motion is one of its starting points, one of its undefined, or primitive, terms. This is its answer to the question: What is motion?

You have heard many stories about Diogenes. He lived in a barrel. He threw away his drinking cup when he noticed a boy drinking out of the hollow of his hand. He told his visitor, Alexander the Great, that the only favor the mighty conqueror could possibly do him was to step aside so as not to obstruct the sun for the philosopher. Well, there is also the story that when Diogenes was told of Zeno's arguments about the impossibility of motion, he arose from the place where he was sitting on the ground alongside his barrel, took a few steps, and returned to his place at the barrel without saying a single word. This was the celebrated Cynic philosopher's "eloquent" way of saying that motion *is*. And did he not also say at the same time that motion is an "undefined term"?

St. Augustine (354–430) used an even more convincing method to emphasize the same point. He wrote:

> When the discourse [on motion] was concluded, a boy came running from the house to call for dinner. I then remarked that this boy compels us not only to *define* motion, but to see it before our very eyes. So let us go and pass from one place to another, for that is, if I am not mistaken, nothing else than motion.

The revered theologian seems to have known, from personal experience, that nothing is as likely to set a man in motion as a well-garnished table.

LET us now turn to the second part involved in Zeno's paradoxes, namely, how to account for motion in a rational way. All science may be said to be an attempt to give a rational account of events in nature, of the ways natural phenomena run their courses. The scientific theories are a rational description of nature that enables us to foresee and foretell the course of natural events. This characteristic of scientific theories affords us an intellectual satisfaction, on the one hand, and, on the other hand, shows us how to control nature for our benefit, to serve our needs and comforts. *Prévoir pour pouvoir,* to quote Henri Poincaré. A scientific theory, that is, a rational description of a sector of nature, is acceptable and accepted only as long as its previsions agree with the facts of observation. There can be no bad theory. If a theory is bad or goes bad, it is modified or it is thrown out completely.

"Achilles" is an attempt at a rational account of a race, a theoretical interpretation of a physical phenomenon. The terrible thing is that Zeno's theory predicts one result, while everybody in his senses knows quite well that exactly the contrary actually takes place. Aristotle in his time and day felt called upon to use all his vast intellectual powers to refute the paradox. Our present intellectual climate imposes no such obligation upon us. If saying that in order to overtake the tortoise Achilles must first arrive at the point from which the tortoise started, etc., leads to the conclusion that he will never overtake the creeping animal, we simply infer that Zeno's theory of a race does not serve the purpose for which it was created. We declare the scheme to be unworkable and proceed to evolve another theory which will render a more satisfactory account of the outcome of the race.

That, of course, is assuming that the theory of Zeno was offered in good faith. If it was not, then it is an idle plaything, very amusing, perhaps, very ingenious, if you like, but not worthy of any serious consideration. There are more worthwhile ways of spending one's time than in shadow boxing. Our indifferent attitude towards Zeno's paradoxes is perhaps best manifested by the fact that the article "Motion" in the *Britannica* does not mention Zeno, whereas Einstein is

given considerable attention; the *Americana* dismisses "Motion" with the curt reference "see Mechanics."

Consider an elastic ball which rebounds from the ground to $\frac{2}{3}$ of the height from which it fell. When dropped from a height of 30 feet, how far will the ball have traveled by the time it stops? Any bright freshman will immediately raise the question whether that ball will ever stop. On the other hand, that same freshman knows full well that after a while the ball will quietly lie on the ground. Will we be very much worried by this contradiction? Not at all. We will simply draw the conclusion that the law of rebounding of the ball, as described, is faulty.

The difficulties encountered in connection with the question of a variable reaching or not reaching a limit are of the same kind and nature. The mode of variation of a variable is either a description of a natural event or a creation of our imagination, without any physical connotation. In the latter case, the law of variation of the variable is prescribed by our fancy, and the variable is completely at our mercy. We can make it reach the limit or keep it from doing so, as we may see fit. In the former case it is the physical phenomenon that decides the question for us.

Two bicycle riders, 60 miles apart, start towards each other, at the rate of 10 miles per hour. At the moment when they start a fly takes off from the rim of the wheel of one rider and flies directly towards the second rider at the rate of 15 miles per hour. As soon as the fly reaches the second rider it turns around and flies towards the first, etc. What is the sum of the distances of the oscillations of the fly? In Zeno's presentation the number of these oscillations is infinite. But the flying time was exactly 3 hours, and the fly covered a distance of 45 miles. The variable sum actually reached its limit.

The sequence of numbers $1, \frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \ldots$ obviously has for its limit zero. Does the sequence reach its limit? Let us interpret this sequence, somewhat facetiously, in the following manner. A rabbit hiding in a hollow log noticed a dog standing at the end near him. The rabbit got scared and with one leap was at the other end; but there was another dog. The rabbit got twice as scared, and in half the time he was back at the first end; but there was the first dog, so the rabbit got twice as scared again, etc. If this sequence reaches its limit, the rabbit will end up by being at both ends at the same time.

If a point Q of a curve (C) moves towards a fixed point P of the curve, the line PQ revolves about P. If Q approaches P as a limit, the line PQ obviously approaches as a limiting position the tangent to the curve (C) at the point P; and if the point Q reaches the position P or, what is the same thing, coincides with P, the line PQ will coincide with the tangent to (C) at P.

If s represents the distance traveled by a moving point in the time t, does the ratio s/t approach a limit when t approaches zero as a limit? In other words, does a moving object have an instantaneous velocity at a point of its course, or its trajectory? Aristotle could not answer that question; he probably could not make any sense of the question. Aristotle agreed with Zeno that there can be no motion in the Now (moment). But to us the answer to this question is not subject to any doubt whatever: we are too accustomed to read the instantaneous velocities on the speedometers of our cars.

The divisibility or the nondivisibility of time and space was a vital question to the Greek philosophers, and they had no criterion according to which they could settle the dispute. To us time and space are constructs that we use to account for physical phenomena, con-

structs of our own making, and as such we are free to use them in any manner we see fit. Albert Einstein did not hesitate to mix the two up and make of them a space-time continuum when he found that such a construct is better adapted to account for physical phenomena according to his theory of relativity.

I HAVE dealt with the two parts of Zeno's paradoxes: the definition of motion and the description of motion. There is, however, a third element in these paradoxes, and it is this third element that is probably more responsible for the interest that these paradoxes held throughout the centuries than those I have considered already. This is the logical element.

That Zeno was defending an indefensible cause was clear to all those who tried to refute him. But how is it possible to defend a false cause with apparently sound logic? This is a very serious challenge. If sound logic is not an absolute guaranty that the propositions defended by that method are valid, all our intellectual endeavors are built on quicksand, our courts of justice are meaningless pantomime, etc.

Aristotle considered that the fundamental difficulty involved in Zeno's argument against motion was the meaning Zeno attached to his "Now." If the "Now," the moment, as we would say, does not represent any length of time but only the durationless boundary between two adjacent intervals of time, as a point without length is the common boundary of two adjacent segments of a line, then in such a moment there can be no motion; the arrow is motionless. Aristotle tried to refute Zeno's denial of motion by pointing out that it is wrong to say that time is made up of durationless moments. But Aristotle was not very convincing, judging by the vitality of Zeno's arguments.

Our modern knowledge of motion provides us with better ways of meeting Zeno's paradoxes. We can grant Zeno both the durationless "Now" and the immobility of the object in the "Now" and still contend that these two premises do not imply the immobility of the arrow. While the arrow does not move in the "Now," it conserves its capacity, its potentiality of motion. In our modern terminology, in the "Now" the arrow has an instantaneous velocity. This notion of instantaneous velocity is commonplace with us; we read it "with our own eyes" on our speedometers every day. But it was completely foreign to the ancients. Thus Zeno's reasoning was faulty because he did not know enough about the subject he was reasoning about.

Zeno's apparently unextinguishable paradoxes, as they are referred to by E. T. Bell in an article recently published in *Scripta Mathematica*, will not be put out of circulation by my remarks about them. I have no illusions about that; neither do I have any such ambitions. These paradoxes have amused and excited countless generations, and they should continue to do so. Why not?

SOPHIE GERMAIN

By JESSE A. FERNÁNDEZ MARTÍNEZ

If a thin circular sheet of metal be fastened firmly at the center by a clamp and if a violin bow be drawn across its edge, a musical note will be produced. The plate is thrown into vibration by the bow; the vibration does not all come up at once or all go down at once, but divides itself into some even number of sectors, say, six or eight, and as one sector goes up the sector on each side of it goes down. The line between two adjacent sectors goes neither up nor down but remains at rest. If sand be scattered evenly over the plate before the musical note is produced, it will be shaken off the parts which are most in motion and it will collect in the lines of rest, or "nodal lines," as they are called. Different musical notes cause the plate to be differently divided up, and the state of vibration of the plate is made plain to the eye by the lines of sand marked out on it. This experiment, a very striking one at that time, was performed at Paris soon after its discovery by Chladni in 1808. It created a great sensation, and a commission was appointed to repeat it with various modifications and to make a report upon it. The Institute of France, at the suggestion of Napoleon, offered its Grand Prix for a mathematical discussion of the phenomenon. Great mathematicians were not lacking in Paris at the time—Lagrange, Laplace, Legendre, Poisson, Fourier—but none of them was inclined to undertake this problem; Lagrange, in fact, had said that it could not be solved by any of the then known mathematical methods. The offer was twice renewed by the Institute, and in 1816 the prize was conferred upon a woman, Mlle Sophie Germain.

It is very remarkable that so great a distinction as to have received the prize of the Institute of France for a profound mathematical discussion should not have preserved the name of Sophie Germain from oblivion, but it has not done so. There are probably not a score of persons in this country who have ever heard of her, and in her own country she is not usually mentioned among its famous women. As proof that women may be pure mathematicians, Mrs. Somerville, outside of Italy and Russia, has had to stand alone. This is unfortunate, for the detractors of her sex have maintained that her work, though exceedingly profound, was not remarkable for originality. That charge cannot be brought against Sophie Germain. She showed great boldness in attacking a physical question which was at that time entirely outside the range of mathematical treatment and the more complicated cases of which had not been submitted to analysis at the time. The equation of elastic lamina, which is still called Germain's equation, formed the starting point of a new branch of the theory of elasticity. In her later years Sophie Germain turned her attention to questions of philosophy, and a high German authority discovered that her philosophical writings contain the germ of the Positive Philosophy of Comte. It is a curious thing that a woman so deserving of recognition has not received it in a fuller measure; it must be looked upon as one of those accidents by which the distribution of praise for merit is too often badly regulated. A mathematician, so remote is his subject from the ordinary concerns of men, has to be a very great mathematician indeed to be so much as heard of by the general public. Sophie Germain, besides deserving remembrance on account of her contributions to science, had

a charming personality, and the few details that have been preserved concerning her life are not without interest. The authority for them is an article by Libri, the Italian mathematician, which appeared in the *Journal des Débats* at the time of her death. Later writers, including the author of the biography prefixed to the new edition of her philosophical works, which was published in 1879 (Paris: P. Ritti), have added little that is important to his account.

On April 1, 1776, in a modest house in the Rue Saint Denis in Paris, Marie Sophie Germain was born. Her parents were Ambroise François Germain and Marie Madeleine Gruguelu. Not much can be told about her family. It is known only that her father, a skillful goldsmith, belonged to the cultivated and liberal *bourgeoisie*, and that he was the partizan, if not the friend, of the philosophers and the political economists. It is plain that she must have passed her earliest years in a family in which there were plenty of serious subjects for conversation. She soon exhibited great maturity of intellect and remarkable depth of feeling. Her gloomy anticipations concerning the future of her country were a distinct cause of suffering to her, and she sought for some occupation sufficiently absorbing to distract her attention from her fears. At the age of thirteen she was one day turning over the pages of Montucla's *History of Mathematics* in her father's library when she came upon the eloquent account of the death of Archimedes—how he was so absorbed in the consideration of a geometrical figure that he heard nothing of the taking of Syracuse, or of the plundering of the city, and that, when a Roman soldier appeared before him, he met death at his hands without raising his eyes from his work. She conceived a sudden passion for a science that could induce such absolute concentration and such total oblivion from the cares and griefs of life and she resolved at that moment to devote herself to the study of mathematics. That resolution she carried out. She had no teachers, she had few books, but she had an unlimited store of energy. She studied day and night. Her family were alarmed at so much ardor and endeavored to turn her attention to more ladylike pursuits. They tried the plan of putting out her fire and taking away her clothes at night, but she was found in the morning wrapped up in blankets, absorbed in her studies in a room so cold that the ink was frozen in the inkstand. It is a curious coincidence that at that very same time, Mrs. Somerville, in her little village in Scotland, was obliged to wrap herself up in blankets to pursue her studies before breakfast, because her whole day had to be devoted to the practice of music and painting and to her lessons at the shop of the pastry cook. Before a strength of will so remarkable at her age Sophie Germain's family at last yielded, and she was allowed to dispose of her time and her talents as she pleased.

But no matter what the energy brought to bear upon them, the higher mathematics present a long and toilsome course of study to anyone who wishes to master them. Sophie Germain carried on this laborious work with constantly increasing satisfaction. Toward the end of her life she still spoke with animation of the happiness she experienced when she first found herself in a position to take up the Differential Calculus of Cousin. But soon a new difficulty presented itself. It was absolutely necessary to her further progress that she should read certain works which were in Latin, and she did not understand that language. Unaided and alone, she learned it and in a short time she was able to read the works of Euler and Newton. Her ambition at this time took a

wider range, and, carried away by the philosophical spirit which held sway in the great *Encyclopédie,* she extended her reading over the entire field of the sciences and laid the foundations for that work which, forty years later, was to secure her a place among the founders of the Positive Philosophy.

In 1794 the École Polytechnique was founded. Legrange, Prony, Fourcroy, and Monge were among its lecturers. Sophie Germain was then eighteen years of age. Anxious to profit by so valuable a means of instruction, she procured for herself students' notebooks, especially of the courses in the chemistry of Fourcroy and in the analysis of Lagrange. She did more. The students were in the habit of handing in to the professors at the end of a course their observations on the lectures they had attended. Under the supposed name of a student, Le Blanc, she sent her notebooks to Lagrange. He noticed them, publicly praised them, found out their real author, and, having made her acquaintance, became the friend and counselor of the young mathematician. The circumstances under which she was discovered, the approbation of the illustrious author of the *Mécanique Analytique,* her youth, some details concerning her studies—all this excited attention and procured for her sympathetic friends. Soon she had established relations, either directly or by correspondence, with all the learned men of the period. Everyone was solicitous of the honor of being presented to her, learned works were dedicated to her, and her house became a center for the brilliant conversation of the most distinguished men of the day.

Some years later, Gauss's great work on the *Theory of Numbers* appeared. Mlle Germain at once turned her attention to this subject. She made numerous researches in it and, under the pseudonym of Le Blanc, she sent her notes to the celebrated professor of Göttingen, persuaded, she wrote, that he would not "disdain to enlighten with his advice an enthusiastic amateur of that science which he cultivates with such brilliant success." M. Le Blanc was far from being an amateur, and Gauss was soon aware of it. His answer contained a warm recognition of her talents, and a friendly intercourse was kept up between them for several years without his becoming aware of the sex of his correspondent.

In 1808 Sophie Germain contended for the prize offered by the Institute for the best memoir giving the mathematical theory of elastic surfaces and comparing it with experience. She deduced the equation of these surfaces from a certain hypothesis concerning the forces of elasticity, but there was an error in her mathematics, and her equation was not correct. Lagrange, to whom the paper had been referred, deduced from the same hypothesis the equation which is still recognized as the correct one. Sophie did not receive the prize. Two years later she sent in a second memoir, in which the same equation is correctly given, and a more complicated hypothesis leads to the equation for the state of things which obtains at the boundaries of the elastic plate. Her theoretical solution she had also confirmed by a long series of experiments. This paper received honorable mention. Nothing daunted, she tried a third time and received the prize, although the commission was not absolutely satisfied with the rigor of her demonstration. Germain's equation for elastic plates is still the fundamental equation of the theory. Her boundary equations have not stood the test of time; fourteen years later Poisson gave a different set of boundary equations based upon a different hypothesis, and in 1850 Kirchoff showed that neither hypothesis was tenable and that neither set of equations was correct.

In 1824 she sent another paper to the Institute entitled, "On the Employment

of the Thickness in the Theory of Elastic Surfaces." This paper was given to a commission consisting of Poisson, Prony, and Laplace. They never brought in their report, and Sophie was never able to regain possession of the manuscript. Only a few years after her death it was discovered among the papers of Prony and it was reprinted entire in a supplement to Liouville's *Journal des Mathématiques.*

Not spoiled by her success, Sophie Germain continued her studies with all her former enthusiasm. She attended the sessions of the Academy of Sciences, kept herself abreast of the scientific researches of her contemporaries, and found time to perform various friendly offices for her acquaintances. She contributed to the *Annales de Physique et de Chimie* an examination of the principles which lead to the laws of movement of elastic solids. In this paper she establishes, in opposition to Poisson, that no hypothesis in regard to the molecular constitution of bodies is necessary in a discussion of elasticity. Her views on this subject have been confirmed. Two papers of hers in *Crelle's Journal*—one on the curvature of surfaces and one on the theory of numbers—were composed by her during the noise of the cannon of the July 1830 revolution. Her hope of finding a profound absorption had not been disappointed.

There are many testimonials to the charm of her character and of her conversation. She was imbued with a pure love of science and was remarkably indifferent to her own fame. She rejoiced when ideas which she had let fall in conversation were appropriated by others. It made no difference, she said, from whom an idea came; it was only of consequence that it should be true and useful. Fame she defined to be the small space which one occupies in the brains of his neighbors—a definition which Schopenhauer later repeated. Virtue she looked upon as a sense of order, which the cultivated understanding must admire, even when the heart does not love it. Her conversation was full of gaiety and freshness and bore constant marks of originality of thinking and of a poetic handling of her thoughts. She died at the age of fifty-five. Her grave is at Père Lachaise, near that of Comte.

The philosophical writings of Sophie Germain were given to the world two years after her death by her nephew Lherbette. Besides some detached thoughts, they consist of a long article entitled "Considerations on the State of the Sciences and of Letters at the Different Periods of Their Culture." Her main idea is the extension of the principles of law and of the harmonious interaction of causes which prevail in the physical sciences, to the regions of politics, of morals, and of art—the same idea which Comte expounded with much greater detail in his *Cours de Philosophie Positive.* Comte's indebtedness to Condorcet and to Saint-Simon has frequently been mentioned. It is only recently that it has been discovered how distinctly he was anticipated in the main features of his system by Sophie Germain. Dühring, in his *Critical History of Philosophy from Its Beginnings to the Present Time* (3rd ed., Leipsic, 1878), says, after giving a full abstract of her work: "One sees from the above that the Positivism which, without the use of the word, one finds in the writings of Sophie Germain, contains the essential features of that which has hitherto been associated with the name of Auguste Comte." The *Zeitschrift für Philosophie* has had two long articles by Göring entitled: "Sophie Germain as the Predecessor of Comte." Her "Considerations" are still very interesting reading, even in times like ours.

IRA REMSEN AND ROGER ADAMS—A CHEMICAL CENTENNIAL

By WINSLOW H. HARTFORD
MUTUAL CHEMICAL COMPANY OF AMERICA, BALTIMORE

THE year 1946 marks the one-hundredth anniversary of the birth of Ira Remsen, first professor of chemistry and second president of The Johns Hopkins University. The chemists of Maryland, through the Maryland Section of the American Chemical Society, have appropriately chosen this year to initiate a series of lectures in his honor, and Professor Roger Adams of the University of Illinois was selected as the first Remsen Lecturer.

The first lecture, "Chemical Research in the War and Post-War Period," was given in Remsen Hall of Johns Hopkins University on May 24.

Behind this statement of academic activity lies a story reflecting in miniature the transfer of supremacy in chemical attainment from Germany to the United States, and with it in great measure the technical skill which spelled success for the United Nations in World War II.

Ira Remsen was born in New York City on February 10, 1846.[1] Following a public school education and a partial course at the Free Academy—now the College—of the City of New York, he was apprenticed by his father to a medical man who taught at a homeopathic medical college. This instruction proved woefully inadequate, but in Remsen's insatiable reading the seeds were sown for his eventual career in chemistry. As Remsen related in one of his many addresses in later years:

> While reading a textbook of chemistry, I came upon the statement "nitric acid acts on copper." I was getting tired of reading such absurd stuff and I determined to see what this meant. Copper was more or less familiar to me, for copper cents were then in use. I had seen a bottle marked "nitric acid" on a table in the doctor's office where I was then "doing time." I did not know its peculiarities, but I was getting on and likely to learn. The spirit of adventure was upon me.
>
> Having nitric acid and copper, I had only to learn what the words "acts upon" meant. . . .

IRA REMSEN, 1846–1927
THIS PHOTOGRAPH WAS TAKEN IN 1922.

> All was still. In the interest of knowledge I was even willing to sacrifice one of the few copper cents then in my possession.
>
> I put one of them on the table; opened the bottle marked "nitric acid"; poured some of the liquid on the copper; and prepared to take an observation. But what was this wonderful thing I beheld? The cent was already changed, and it was no small change either. A greenish blue liquid foamed and fumed over the cent and over the table. The air in the neighborhood of

[1] For this and other biographical information, the author is indebted to F. H. Getman's *Life of Ira Remsen*, Chemical Education Publishing Co., Easton, Pa.

REMSEN HALL AT JOHNS HOPKINS

the performance became colored dark red. This was disagreeable and suffocating. How should I stop this?

I tried to get rid of the objectionable mess by picking it up and throwing it out of the window, which I had meanwhile opened. I learnt another fact—nitric acid not only acts on copper but it acts upon fingers. The pain led to another unpremeditated experiment. I drew my fingers across my trousers and another fact was discovered. Nitric acid acts upon trousers.

Taking everything into consideration that was the most impressive experiment . . . I ever performed. . . . It resulted in a desire on my part to learn more about that remarkable kind of action. Plainly, the only way to learn about it was to see its results, to experiment, to work in a laboratory.

During this "medical instruction," Remsen was also asked to aid his teacher in presenting chemical experiments which neither he nor his teacher had ever performed or seen. The results can be imagined. Such instances were typical of American chemistry and chemical instruction in 1865. Only a few trained chemists were teaching anywhere in the country. Dr. Charles A. Browne writes:

The effects of the Civil War on chemical education in America were in the nature of an overwhelming catastrophe. Professors and pupils were called from their laboratories . . . and the tide of progress was turned backward for twenty years. . . .

It may be remarked parenthetically that problems arising from the drafting of scientists are evidently not new.

In contrast, in Germany a great upsurge of chemical activity was taking place. With the coming of the year 1860 the groundwork of modern chemistry had been laid, and the laboratories of the great German universities were peopled with men who were giants in their profession. The golden age of German chemistry, which was to hold undisputed sway until 1914, had begun. It was the work of the students of these men—Liebig, Bunsen, Kékulé, Kirchhoff, Wöhler, Hofmann, Volhard, and others—that created the great German chemical industry with which Kaiser Wilhelm II sought to feed his war machine in World War I and that remained a potent factor in Hitler's plans until strategic bombing virtually destroyed it. Although Remsen dutifully completed his medical studies, transferring to the Columbia College of Physicians and Surgeons where he re-

From the Journal of Chemical Education

PLAQUE IN REMSEN HALL

ceived an M.D. in 1867, he never practiced this profession. Soon after his graduation he sailed for Germany to follow his suppressed bent for chemistry and to gain inspiration from the wealth of genius then in the German universities. After studying for some time under Volhard at Munich, he received his Ph.D. for work with Fittig at Göttingen in 1870. He remained in Germany for two years as Fittig's assistant and returned to the United States in 1872, seeking opportunity in teaching and research.

After a period of bitter discouragement, during which he completed a translation of Wöhler's German text on organic chemistry, Remsen accepted a teaching post at Williams College in Williamstown, Mass. Here he found meager facilities—no research laboratories—for the college expected chemistry to be taught in the classical tradition as a cultural subject. So talented an instructor was young Remsen, however, that the college later yielded to his request for a research laboratory. Here he continued the work he had started in Germany, and it was while he was at Williams that he wrote his *Theoretical Chemistry*, which was the first of eight textbooks written by him. These went through as many as eight editions and were translated into German, Italian, French, Russian, Finnish, Polish, Chinese, and Japanese. It was in this connection that Dr. Isaiah Bowman, president of The Johns Hopkins University, said at the first Remsen Memorial Lecture:

> The total of these figures [the sale of Remsen's textbooks] is close to half a million and if we consider how books are often bought and resold by students it is clear that something above seven figures measures the number of students who used Ira Remsen's textbooks. That is almost equal to the prewar enrollment of all the colleges and universities in the United States—truly a great host. . . . It is well within the truth, therefore, to say that millions of students in practically all of the scientifically progressive countries of the world studied in the laboratory and felt the intellectual impulse of Ira Remsen.

On the death of Johns Hopkins in 1873, it was revealed that his will provided the sum of $7,000,000 for the founding of a hospital and university. The work that Professor Remsen had done at Williams had made him a well-known figure in American chemistry, and in 1876 he was offered and accepted the position of Professor of Chemistry at the new Johns Hopkins University in Baltimore. Just as this university pioneered in graduate studies in science in America, so Ira Remsen became the leader of modern American chemistry. Dr. Benjamin Harrow says in his book *Eminent Chemists of Our Time:*

> Remsen was the first professor of chemistry at the first institution ever established in America for graduate work—Johns Hopkins. . . . As teacher, as research worker, and as a writer he is more directly responsible for the development of the science in the United States than any other man.

From 1876 until he became President of the University in 1901, Remsen gloried in a quarter-century of research and teaching which has had few equals in its effects. Among his students were such men as Professor James F. Norris, of M.I.T.; Professor Lyman C. Newell, of Boston University; Professors E. Emmet Reid and J. W. Frazer, of Johns Hopkins; Professor W. A. Noyes, of the University of Illinois; and many others who passed on the inspiration given them by Remsen. It was due in large measure to the work of Remsen's students that when World War I cut off the supply of German chemicals, medicines, and dyes American chemistry rose to the occasion and met the nation's needs.

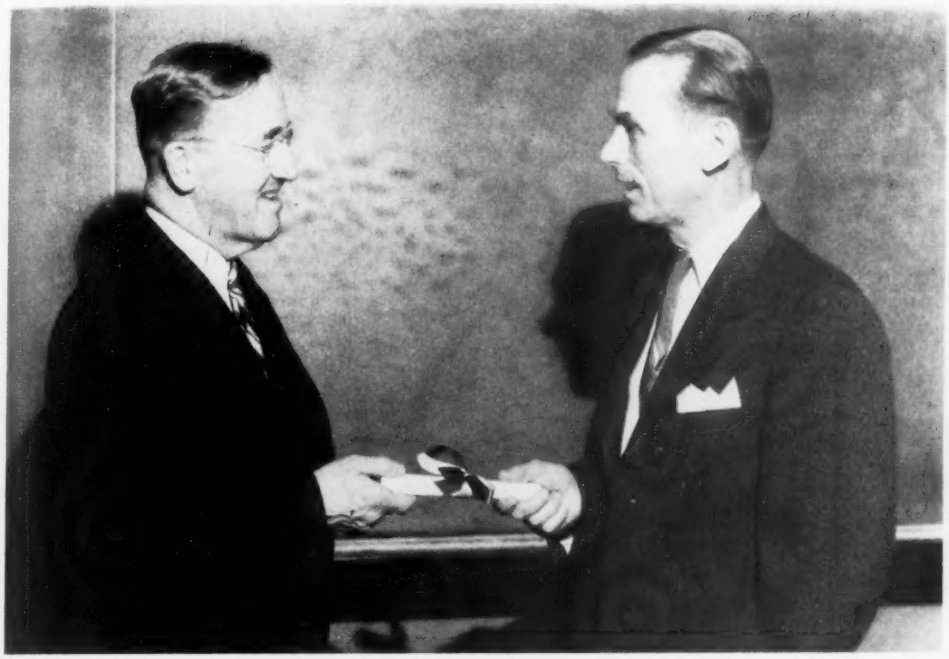
His research for the most part proved Remsen a chemists' chemist. He authored or directed work leading to the publication of some 156 papers, most of them solid contributions to the fundamental knowledge of organic chemistry, that branch of science which yields us dyes, medicinals, insecticides, lacquers,

plastics, and most of the modern "synthetics" which have aided man's progress through the years.

The extent to which Remsen was concerned with fundamentals is best illustrated by an anecdote regarding his discovery of benzosulfimide, or saccharin. This compound was investigated by Remsen and a graduate fellow from Germany named Fahlberg. The usual scientific paper was published, and Remsen went on to correlate the reactions of the new compound with those of other similar organic compounds. Fahlberg, however, was an opportunist if ever there was one and promptly applied for a patent on the material and obtained it. Fahlberg assigned half his rights to a German concern with which he entered into partnership for the manufacture of saccharin. Although his many friends urged Remsen to contest the patent, he never did so. "I did not want his [Fahlberg's] money," said Remsen, "but I did feel that I ought to have received a little credit for the discovery."

Although the general public may remember Remsen as the president of The Johns Hopkins University, where he served from 1901 to 1912, and Baltimoreans will recall his public service on the Baltimore School Board, the Good Roads Board, the Sewage Commission, and President Theodore Roosevelt's Pure Food Board, it is as an outstanding

ROGER ADAMS AND ISAIAH BOWMAN
AT THE DINNER TENDERED DR. ADAMS BEFORE HIS REMSEN MEMORIAL LECTURE.



PRESENTATION OF THE REMSEN LECTURESHIP AWARD

GILES B. COOKE, CHAIRMAN OF THE MARYLAND SECTION OF THE AMERICAN CHEMICAL SOCIETY PRESENTS THE SCROLL SHOWN BELOW TO ROGER ADAMS, UNIVERSITY OF ILLINOIS, THE FIRST REMSEN LECTURER.

chemist that he served his country best. His own profession honored him: with the presidency of the American Chemical Society, the American Association for the Advancement of Science, and the National Academy of Science. He received many medals and honorary degrees as well.

Ira Remsen died on March 4, 1927, at the age of eighty-one. His ashes rest in an urn sealed in the wall of Remsen Hall at Homewood.

IT IS fitting that the Maryland Section of the American Chemical Society should create the Remsen Memorial Lecture Award as a recognition of American chemists whose attainments continue the distinguished pattern that Ira Remsen created. It is particularly fitting that Professor Roger Adams should be the

Presented to

Roger Adams

on the occasion of his

Remsen Memorial Lecture

sponsored by

The Maryland Section of the American Chemical Society

in memory of

Ira Remsen

Teacher, Investigator, Author, Administrator

May 24, 1946

first Remsen Lecturer. For, as Ira Remsen brought to this country the genius of German chemists of the seventies and laid the foundations of modern American chemical research, so Roger Adams completes the cycle. It will be largely his responsibility, as Chairman of the FEA Committee on Chemical and Engineering Research Control in Germany and as Scientific Advisor to the Deputy Military Governor of Germany, to determine the future of German chemical progress. Trained chemists and a fundamental chemical research program are today as much a part of a country's resources as steel or oil or food. This Professor Adams must bear in mind in his inspection of an industry once great and now badly damaged by strategic bombing attacks. Few will deny that the final victory of the war was a victory of Allied scientific and technical achievement as well as of Allied manpower and yet one in which inspections within Germany have revealed an uncomfortably narrow margin of supremacy. Recommendations for the continuance of German scientific work cannot fail to be greatly influenced by the opinion of Dr. Adams. It is in the hands of men of his stamp that the future of Germany may well rest.

Like Remsen, Dr. Adams has achieved distinction in his profession. He has been president of the American Chemical Society and is now Chairman of its Board of Directors. He has received the Nichols Medal, the Davy Medal of the Royal Society of London, and this fall will receive American chemistry's highest award, the Priestley Medal of the American Chemical Society. Honorary degrees have been conferred on him by the Polytechnic Institute of Brooklyn, Northwestern University, The University of Rochester, and Harvard University. Professor Alsoph Corwin, Chairman of the Chemistry Department of The Johns Hopkins University, in introducing Professor Adams, said of him:

> In the fall of 1910 . . . the first scientific paper appeared in which Roger Adams was co-author. This initiated one of the most remarkable records of chemical publication in existence. During the past three decades, he has published solid, scholarly contributions to the science and art of chemistry at the sustained average rate of one a month.
>
> . . . First of all, he is a chemists' chemist. He has made numerous contributions to the techniques of the laboratory, improving methods of identification and preparation of new substances, devising new methods of synthesis and in general lightening the load of the practitioner of the art. He has made extensive contributions to our understanding of chemical reactions, chemical structures and chemical theory. . . . These things are the bread and meat of the contemplative scientist seeking understanding. . . . Outstanding in this field is his classical study of the structure and synthesis of substances useful in the control of leprosy. It is difficult to overestimate the significance of this total contribution in terms of human comfort and human welfare.

This, in brief, is a picture of the man whom Maryland chemists are honoring in the name of Maryland's great chemist, Ira Remsen. His talk to the Maryland Section of the American Chemical Society on the occasion of the presentation of the Remsen Memorial Lecture Award was a reminder not only to chemists, but to the American people, of the vital significance of chemistry in the present political and economic picture.

Of Germany, Professor Adams says, in part:

> Research in Germany was stopped abruptly on V–E Day. In the United States zone permission was given by the AMG for the resumption of a limited amount of research in one or two industrial concerns in specified fields of chemistry. A law for the control of research has just been promulgated which will make it possible for the resumption of both industrial and academic scientific research under supervision. . . . However, it is difficult to envisage how any extensive research program can function in the near future. Many of the plants of the I. G. Farbenindustrie, which employed 90 percent of the German chemists, will probably be destroyed or

eliminated through reparations, and there will be left merely smaller industrial chemical units competitive in character. The money available for both academic and industrial research will be much more restricted than before the war. . . . For some time to come it will be impossible to obtain glassware, physical equipment, and many of the needed chemicals. With conditions of semistarvation, lack of fuel, clothing, and other necessities of life in addition, the German scientist will be working under unbelievably difficult circumstances. The ideal conditions that existed in Germany for facilitating research and for investigators are gone and perhaps may never be recovered. But the will to succeed has not yet disappeared, and scientists, notably ambitious, will do their best to produce with whatever facilities are available to them. It is the current belief among German scientists that they as a class have a major responsibility to again bring their country to a leading position.

Thus we trace a full swing of the pendulum in chemistry: from the student days of Ira Remsen when Americans brought the beginnings of a great industry to this country from the great talents of German universities; to today when men like Professor Adams signify the commanding position to which American chemistry has risen.

In Professor Adams' talk to the Maryland chemists he detailed many of the great wartime chemical discoveries, culminating in the chemistry of new elements such as plutonium and its part in the atomic bomb project. But in closing he speaks for the scientific future of America:

Progress in applied science depends on advance in fundamental science. The power of science in the United States will be no more effective than the quality of our teachers and students who create the background for future industrial discoveries. Once again I quote Kapitza [P. L. Kapitza, the world-renowned Russian physicist and Russia's most distinguished scientist] who pleaded for recognition of fundamental science and its importance: "We, however, are often apt to judge scientific attainments only by their practical results and consequently it appears as if the person who picked the apple had done the main job, while in actual fact, the apple was created by the person who planted the tree."

The strength of a country has depended in the past on its possessions, in earlier days on land, its control of transportation and waterways, or its supply of raw materials, but today a nation's strength will be largely in the quality of its scientists. Governments must support the work of scientists but not control it in such a way as to hamper development or to direct it into military channels. . . . Nuclear energy, the scientific discovery of the present day which has shown its power to destroy, will undoubtedly be turned from instrumentalities of war to applications for the welfare of all.

PLANT PROTECTION IN THE BELGIAN CONGO

By R. L. STEYAERT

INSTITUT NATIONAL POUR L'ETUDE AGRONOMIQUE DU CONGO BELGE

TO WRITE for Americans even the shortest account of the work accomplished in plant protection in the Belgian Congo it is necessary to give first an insight into the history of the country itself.

Only a little more than seventy years ago this country of a million square miles was *terra incognita*. The last large area to be opened to civilization, it now has 50,000 miles of roads, 3,000 miles of railroads, and 8,000 miles of navigable rivers. Its population is about 14,000,000, including 35,000 Europeans, and it has the highest trade figure per capita in tropical Africa.

Through the discoveries of Henry M. Stanley in the Congo Basin and the enterprise of Belgium's King Leopold II, who enlisted his services, the Congo Free State was founded in 1885 under Leopold's sovereignty. In 1908, a year before the King's death, the Free State became a colony of Belgium.

Agricultural development in the Congo Free State was delayed by many problems involved in opening the country. The energy of the newborn state was taxed to the utmost by a war against Arab slave traders in the eastern half of the country, by the pacification of a motley array of warring tribes, by the organization of inland river transports, the building of a railroad from Matadi to the Stanley Pool in an almost impenetrable country, and the fight against sleeping sickness. It was only at the turn of the century that agricultural experiment stations were founded, including a botanical garden in Eala. This garden, established by the Belgian botanist E. Laurent and ably managed by Pynaert, played a significant role in the importation of plants and seeds. At the same time a hothouse garden was built on the King's property at Laeken. To all intents and purposes it functioned as a quarantine station.

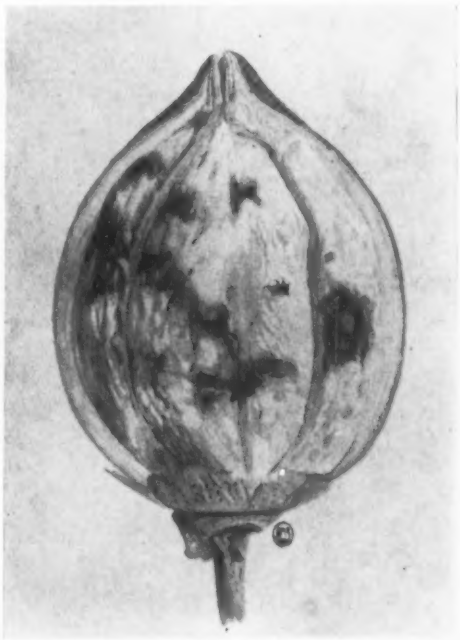
After 1908, with the support of the home country, the agricultural service was organized and a small scientific staff was engaged. This encouraging beginning was dashed by the disaster of World War I. The staff was depleted, and the men who departed could not soon be replaced. During the German occupation of Belgium all the universities and specialized colleges had had to close their doors at one time or another. Thus, not only were there no men to impart knowledge gained by experience,

STUNTED COTTON PLANT
DAMAGED BY *Helopeltis bergrothi*.

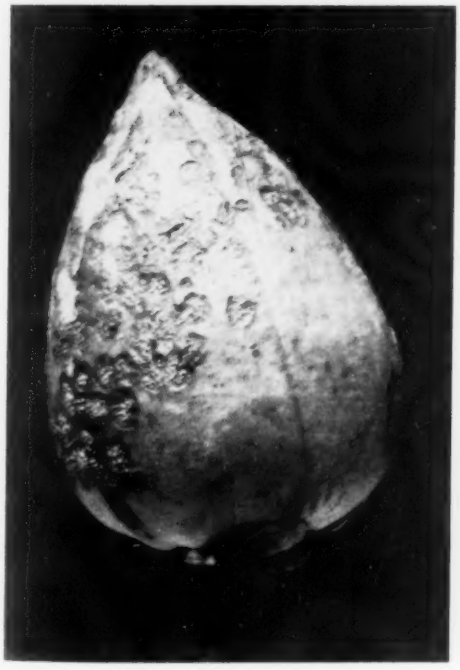
but there were also no responsive young men. The aftermath of the war was not wiped out until the late twenties, when men and capital had come to the colony. From that time dates the true agricultural development of the Congo.

AT PRESENT three crops dominate the agricultural economy: two indigenous plants, oil palm and coffee; and an imported one, cotton.

Cotton. In the scale of importance cotton ranks high, not only economically but politically. Cotton fits perfectly in the rotations practiced by the natives. Moreover, it is an easy cash crop. With this in mind the Administration put cotton under a special status. Paradoxically, though this crop adapts itself well to the shifting conditions of native agriculture, it stabilized the natives themselves by stopping migrations. Regions far away from any navigable rivers or railroads were given a paying crop, thanks to a rapidly developing network of roads. Furthermore, an unexpected result was that food crops were better and more extensively planted.



STIGMATOMYCOSIS
COTTON BOLL ATTACKED BY INTERNAL BOLL ROT.



INJURED COTTON BOLL
PUNCTURED BY *Helopeltis bergrothi*.

Land freshly cleared for cotton bears one or two crops of food plants—corn (maize), rice, or peanuts—as such lands, especially forest soils, are unsuitable for cotton. No wonder, then, that for fifteen years most of the efforts in the development of agriculture were concentrated on this crop. Introduced experimentally in the Lower Congo (estuary of the river) before the first world war, it failed. A new site chosen in the Maniema (east-central Congo) gave much more promising results, but the real development of cotton dates from its introduction into the Uele district in northern Congo. Experiment and research stations mushroomed immediately. Subsequently their number was somewhat reduced, but at present two major and six semipermanent stations are operating. This network is further extended by

"local experiments" in the care of official itinerant agronomists. Progressively, cotton was extended to the savannas south of the equator in the Sankuru district, and by 1938 the production of this part of the colony equaled that of the northern cotton belt. The existence of two cotton belts on either side of the equator is a fortunate circumstance for the national economy, enabling a steady export the whole year round. To illustrate the rapid progress made in the cultivation of cotton, the production of seed cotton in the Belgian Congo is given hereunder in metric tons at five-year intervals:

1923	1,812
1928	14,255
1933	46,264
1938	127,488

In 1940 the production was about 145,000 tons.

Development of cotton has been described in some detail as it accounts for the large amount of work done on the insect pests and diseases of that crop.

Oil palm. The oil-palm industry started during the time of the Congo Free State. To entice capital investments into this barely explored land, monopolies on big zones had been granted, but they concerned solely the buying from the natives of fruit picked from wild plants. No thought had been given to methodical cultivation of the oil palm in plantations. Why do so? Wild palms could be found in plenty, giving an immediate income with little capital outlay. Under stress of international competition such easy methods of exploitation had to be gradually abandoned. Like the seeds of many other plants, those of the oil palm found

COTTON DESTROYED BY *HELOPELTIS BERGROTHI*

their way to the Dutch East Indies. Within a few years the Dutch had selected high yielders and were setting up a menacing competition. In production of palm oil the Belgian Congo found itself in danger of being in a position like that of Brazil with respect to Hevea rubber. Determined not to be outdistanced by the Dutch, the Congo had to adopt more orthodox methods of agriculture. Therefore the Department of Agriculture established a research station close to an already existing government-owned Hevea plantation in Yangambi. In the last decade, with the increasing availability of mass-selected seeds and selected strains, plantations, both European and native, have been cropping up all over the colony.

Tropical agriculture owes to A. Beirnaert invaluable knowledge on the genetics of the oil palm. Breaking ground in its selection, he developed the Tenera hybrid by crossing Dura and Pisifera types. His work remains an outstanding tribute to his memory. The Congo suffered an immense loss when he was killed in 1941 in a motor accident.

Coffee. What has been said of the oil-palm industry applies to the coffee industry, except that the latter has never depended on wild coffee, which is not acceptable to the trade. Coffee was one of the first wild plants to be regularly cultivated, and the Congo Free State encouraged it in every way. However, so many species could be found wild that prospective planters were in a quandary as to which to select, *arabica* coffee having been ruled out by climatic conditions. As happens more often than not in such cases, the wrong ones were planted. Here also one of the Congolese species made its way to Java, where it superseded *arabica* in the low-lying districts. This coffee came to be known as *robusta* (*Coffea canephora* Pierre) in recognition of its resistance to Hemileia

OIL PALM TREE
ATTACKED BY FUNGUS, *Ganoderma lucidum.*

rust. Incidentally, *robusta* brought with it to Java its most troublesome pest: the coffee-berry borer (*Stephanoderes hampei* Ferr).

Unquestionably the Dutch have taken a lead on us in selection of *robusta*. But some of the Java-selected strains have come back to their homeland, and, with the help of those locally produced, many plantations were established after the first world war. Unfortunately, with overproduction looming ahead, the government in 1938 had to limit the increase in acreage. The coffee industry is steadily recovering though, thanks to the guidance of a Coffee Board. Very noticeable improvements in the exports have been recorded of late.

Other crops. In the early days of the colony cacao was for a time in favor with planters, but severe competition from the Gold Coast dampened all further efforts to develop this crop.

On the other hand, Hevea rubber,

ROOTS OF HEVEA
EXPOSED FOR THE CONTROL OF *R. microporus*.

though introduced long ago, was shunned for many years. It is only since 1935, and more especially under the urge of war needs, that it has come into prominence. Expansion of Hevea rubber production might be seriously impaired, however, by conditions that will be mentioned later.

Many other products, such as corn, peanuts, rice, an indigenous fiber, *Urena lobata*, citrus, banana, and sisal, are being exported in increasing quantities or are being developed for local consumption.

BESIDES the low-lying central plains, whose crops we have discussed, other agricultural districts are situated on the high plateaus bordering the Congo to the east and southeast. In the southeast we have the Katanga plateau, extending roughly between the seventh and fourteenth parallels south, and in the east the Ituri, Kivu, and Ruanda-Urundi plateaus straddling the equator between the third parallel north and the fourth parallel south. In the Katanga a six months' dry season divides the year into summer and winter seasons. The eastern plateaus enjoy two rainy seasons per annum, with a break in the rains, or a dry season of one, two, or three months, according to the remoteness from the equator. The equable or mild climate of these plateaus leaves some prospects for a limited white settlement.

The opening and exploitation of the Katanga copper mines attracted quite a few settlers, and, supplies being scarce, many farmed corn until the railroad from Bas-Congo to Katanga linked the mining districts with those densely populated in the plains. Settlers switched over then to market gardening and fruit and dairy farming, for the products of which they find a ready market in local industrial townships.

The Ituri and Kivu began to be settled only in the middle twenties, settlers concentrating around Lake Kivu and in the northern Ituri. Most planted *arabica* coffee, but in the vicinity of the Ituri gold mines corn and beans were grown. Lately, however, with the rapid development of roads, they too switched over to market and dairy produce, exporting butter, cheese, and vegetables to such faraway townships as Stanleyville, Buta Aketi, and Leopoldville. In the Kivu, cultivation of pyrethrum and Cinchona has developed in the last few years.

The rapidly developing agriculture of the colony has thus been sketched out. If the results are gratifying, many problems remain to be solved, the most urgent being a proper rotation for native agriculture. Not only is it a question of soil conservation but it is also, and perhaps primarily, a forest-conservation problem.

Precariously situated between two big deserts, the central African jungle needs

careful management if the steady encroachments of the northern and southern savannas are to be stopped—an encroachment which many African tribes have encouraged by their deplorable agricultural practices and bush fires. To counter this a system of jungle fallow, aiming at a rapid reintroduction of forest trees in abandoned fields, is being studied.

Until a decade ago progress was gained by rough-and-ready methods, but further progress was barred without a more scientific knowledge of local African conditions than then existed. To meet this need a research institution was founded in 1934, under the name "Institut National pour l'Etude Agronomique du Congo Belge" (INEAC for short). Within this new institution the government incorporated all its experimental stations and scientific staff, retaining only those civil servants indispensable for administrative purposes. The INEAC is liberally organized for ease of scientific and financial operations.

In 1940 the staff for the whole institution numbered about ninety, but it was severely reduced during the war by mobilization and deaths and by members on leave in Belgium who were unable to return because of the invasion. The institution is managed by a committee sitting in Brussels, composed of university professors and leading scientists, and by a Director General whose residence in Africa is in Yangambi.

In this organization the Division of Plant Pathology (including entomology) now has three laboratories in the following stations: Bambesa, Mulungu, and Gandajika. A fourth one was under construction at Yangambi in 1940, which would have been, but for the war, the central laboratory of the Division.

We have said that in 1908, when Belgium annexed the colony, a Department of Agriculture was organized. This new department immediately engaged

BAMBESA
THE LABORATORY OF PLANT PATHOLOGY.

specialists. R. Mayné, the first entomologist, arrived in 1911. F. Vermoesen, having traveled in the East, arrived in the Congo as mycologist, but his inclinations went to botany, and he did very valuable work by describing the principal trees of the Mayumbe forest. Unfortunately, he suffered from ill-health and soon had to leave the service and died in 1922. Mayné kept on until 1921 when he was called upon to fill the vacant professorship of zoology and entomology at the State's Agricultural College of Gembloux. During his sojourn in Africa he was primarily concerned with insect pests of cacao, which he investigated in great detail. The results of his researches were published in London in 1917 by the Belgian government-in-exile. In 1919 J. Ghesquière, at the time recently demobilized from the army, with which he had gone through the whole war, came to the Congo as entomologist. First stationed in the Katanga where he discovered many important insect pests, including *Phthorimaca operculella* Zell. and *Icerya purchasi* Mask., he went ultimately to the Maniema district to investigate the pests on recently introduced cotton.

With Maynć gone, Ghesquière was left alone to cope with an ever-increasing number of pests as the agriculture of the Colony developed. To alleviate the load somewhat, C. Seydel, an amateur lepidopterist, was engaged. From his arrival in 1923 till his retirement in 1939 he was stationed in the Katanga. Due credit must be paid him for the very good work he accomplished in his own specialty.

Ghesquiére greatly enlarged the field of investigation. To him, seconded by his wife, we owe a considerable increase in the knowledge of the distribution of most of the economic insects. In addition to his work in entomology he collected intensively for natural-history museums and botanic gardens. In 1939 he resigned from government service.

Also in 1919 P. Staner, a mycologist, become the first of a series of postwar graduates that were to come to Africa. Unfortunately, he had to resign for personal reasons in 1929. His resignation was indeed a loss as the mycological aspect of plant pathology had scarcely been investigated. It was only with the specialists engaged in 1929 that at last some sort of permanency in the staff was established. In that year the author as mycologist, followed within a few months by Bredo as entomologist, came to the colony. J. Vrydagh as entomologist and Mrs. Soyer as part-time phytopathologist came in next. In 1932 Leroy arrived as entomologist, followed by the entomologists P. Lefèvre in 1932, P. Henrard in 1934, and the mycologists F. L. Hendrickx [sic] in 1938 and J. Moureau in 1940. This staff, with the exception of Leroy, who resigned in 1935, is still on active service. Most of them were stationed in the Eastern Province (now Province Stanleyville) and have gone elsewhere ultimately. Bredo stayed as government entomologist and has been lent to the International Locust Research Board, managed from the Imperial Institute of Entomology in London. Stationed in Abercorn, Northern Rhodesia, he has been mainly concerned with the study of *Nomadacris septemfasciata* Serv. Since the end of World War II we have been able to add three new entomologists to our staff.

Some Insect and Plant Disease Problems

Cotton. In 1930 and 1931 a most severe invasion of *Helopeltis bergrothi* Reut., a mirid bug previously reported on cacao but hitherto unknown on cotton, caused the loss of one-third of the cotton crop. At the same time pink bollworm, *Pectinophora gossypiella* (Saund.), was also discovered, carried into the Congo most probably by the eastern trade winds blowing from the Anglo-Egyptian Sudan. The menace of these two pests sufficed to justify the building of a properly equipped laboratory at the Bambesa Cotton Experiment Station in the Uele district.

The latter pest was soon found to have much less importance than in Egypt, as the work of the new laboratory showed that the insect had no diapause (period of inactivity) under tropical conditions. The seeds being thus noninfective, compulsory seed disinfection with Simon's hot-air machine was waived. On the other hand, stress was laid on the establishment of a closed season devoid of all cotton plants in the field. It is now illegal in the Northern Congo to grow cotton from March till July. This has plainly proved to be the best control measure.

In the southern cotton belt, pink bollworm is unknown except in the Ruzizi Valley, connecting Lakes Kivu and Tanganyika, but bollworm, *Heliothis armigera* Hübn., is sometimes destructive.

Concerning the *Helopeltis* pest very little new knowledge has been gained, the chief reason being that no new severe outbreak has occurred in the Uele district. Sporadically and in limited zones severe outbreaks do occur but are so unpredictable that no research program has been possible. At present control is limited to hand-picking, and premiums are paid in salt, for which the natives are very eager. Hand-picking of the first generation of the insects, invading cotton when it is one or two months old, is especially

stressed. Apparently climatic conditions play an important role. With the development of the weather survey in recent years it has been noticed that certain regions where *Helopeltis* outbreaks are frequent have a climate differing from the rest of the cotton belt.

A leaf disorder called *frisolée* was described in the early days of cotton, but it was not until 1934 that the insect vector was found to be *Lygus simongi* Reut. Damage is very severe on newly cleared land—one of the reasons why food crops are planted before cotton. In the southern cotton belt damage is even more severe than in the North, notwithstanding the fact that it is mainly savanna country. Discrepancies in the general coloration of the insect might indicate that an undescribed variety or species is involved in the South.

Leafhoppers, mainly *Empoasca facialis* Jac., are troublesome in the savanna regions of both cotton belts, though never a limiting factor. One of the Triumph varieties nevertheless suffers a loss of some 15 percent.

Another major cotton pest is the stainer bug. Several species are involved, the four principal ones being: *Dysdercus superstitiosus* Fabr., *D. nigrofasciatus* Stål., *D. melanoderes* Karsch., and *D. fasciatus* Sign. Not only do these insects damage the plants directly, by puncturing bolls and sucking the immature lint and seeds, but they inoculate yeast fungi, causing a dry rot of the lint. This complex was named "stigmatomycosis" by Nowell, who discovered the complex in the West Indies. It has been one of the major objects of research, efforts being directed principally toward devising a technique for the selection of resistant strains. Very little hope can be held of finding direct means of control. Baits have been tried but have brought little reward.

Efforts are being made to select strains resistant to the fungi, *Nematospora coryli* Peg. and *Ashbya gossypii* (A. & N.) Guill. Artificial inoculations have shown sharp differences in their reactions on the bolls of various cotton strains. Selections for resistance to puncturing have been inconclusive, and unfortunately so, because a cotton repellent to the insect or a puncture-resistant one would be the best solution to the problem.

In 1934 *Verticillium dahliae* Kleb. (hadromycosis) was discovered in the Nepoko, but in 1937 a far more serious disease *Fusarium vasinfectum* Atk. (wilt) was discovered at Bambesa Station, causing considerable alarm. Since then many foci have been discovered, mainly in the eastern part of the Uele district, in northern Sankuru, and in western Ubangi. The primary infections of these foci have been traced in most cases to Wonder Dixie Triumph seeds imported from the United States. To retard the extension of this disease strict quarantine measures have been enforced on the propagation of seed within the territory of the Colony. Selection for resistance, started in 1939, is making good progress and is conducted in fields where fortuitous soil infection is supplemented by artificial inoculations.

Attempts to isolate the toxin or toxins secreted by the fungus have led to positive results with at least one of them: a crystalline product, reproducing the symptoms of the disease in the fibrovascular bundles and the wilting of plants, has been isolated. These researches are being conducted at the Bambesa laboratory. Wilt is a serious menace to the cotton industry as most of the Congo soils are of light texture with a pH below 7—conditions conducive to high virulence in the American biotype of *F. vasinfectum*. Furthermore, climatic conditions and soil temperatures approaching or within the optimum conditions of growth for the fungus exist the whole year round.

Many other pests occur but are of secondary importance. Exception must be made, however, for one recently discovered in the southern cotton belt: *Paurocephala gossypii* Russell, a psyllid. No species of this family had hitherto been recorded on cotton the world over. Its effect on the plant is evidenced by bronzing, shedding of the leaves, dwarfed new growth, and complete sterility. It is the main research problem of the Gandajika laboratory.

Oil palm. This tree suffers from a variety of diseases and pests which have not as yet been systematically investigated. One must bear in mind that the genetically heterogeneous nature of the existing plantations is not conducive to widespread infestations of particular pests and diseases. Undoubtedly, with the progress of selection, diseases and

pests not prominent now or recorded as yet will acquire economic importance. Careful attention is paid, of course, in selection to ward off such dangers. Tests with the best progenies are replicated in as many regions of the Congo as possible, but this by no means lessens the possibility of new diseases appearing or of a recorded one running wild.

At present *Ganoderma lucidum* (Leys.) Karst., a polyporous fungus attacking the roots and trunk, and *Pimelephila ghesquieri* Tams, a moth, seem respectively to be the most important disease and the most troublesome pest. Spike diseases induced by *Fusarium* spp. and *Pestalozzia* sp. are not infrequent, and certain of them may be considered of major importance. The ubiquitous *Armillaria mellea* (Vahl.) Quel. on roots and trunks has been recorded recently. Considerable attention should also be given to deficiency diseases, indicated by leaf chlorosis.

Rubber. The impetus given to Hevea culture forcibly called attention to its diseases. The alarming incidence of root rots in the new plantations is causing considerable concern, for, unless they can be controlled, they might indeed be limiting factors. The foremost culprit is *Rigidoporus microporus* (Sw.) V.O. (syn. *Fomes lignosus* Klotsch.), or white root rot. This fungus is also very active in tropical Asia, but there are indications that its African strains might be much more virulent than those of Asia. Moreover, virulence is enhanced by the propitious conditions of the African environment.

Partial solution of this problem rests probably upon improved agricultural practices. On the other hand, preliminary observations tend to show that such trees as *Blighia Wildemannianna* Gilg., *Celtis* spp., and *Polyalthia suaveolens* Engl. & Diels., after having been felled in the jungle, leave stumps highly susceptible to vigorous invasion by white root rot, and they bear massive outgrowths of sporophores. This might lead to new practices in jungle clearance: ring barking prior to felling, stump poisoning, or even complete removal of stumps might be means of eliminating the foci of infection. Application of soil fungicides might also be considered, and for this purpose the rich deposits of copper ores to be found in the Colony might provide cheap raw materials.

A coreid bug, *Pendulinus devastans* Dist. has been known to cause considerable damage in certain plantations, especially on young trees. Bites from these bugs soon form cankers, killing off the main shoot. Ultimately new shoots appear in a whorl, and these have to be carefully pruned lest the affected trees become misshapen with a bole difficult to tap.

Coffee. *Robusta* coffee has one major pest, *Stephanoderes hampei* Ferr. Direct measures of control are hard to devise. This scolytid beetle has the peculiar habit of penetrating the berry exclusively through the flower scar. It is only in the case of infestations so high as to leave none of the berries uninfested that the insect may try to gain access to the berries elsewhere. I have even seen shoots harboring the adults, but in that case the trees were growing in the vicinity of the factory where berries were sun-dried. Most of the life of the insect is passed within the berry, where the eggs are laid and the larvae grow and pupate. The mature beetle leaves the berry at sundown, copulates, and immediately digs itself in again. Control can only be obtained by disrupting its annual life cycle: *Robusta* is grown approximately between the fourth parallels north and south. Although on the equator picking goes on the year round, the farther coffee is planted from it, the more restricted the picking season becomes. There may be a long period wherein few berries mature. These suffice, however, to carry the insect from one season to another. To destroy the insects so carried over a so-called sanitary picking is practiced. A month or two after the regular picking season all berries of sufficient size to harbor the insect are pulled from the trees and burned. It may be necessary to repeat this for a second crop out of season. These control measures have proved to be of great practical value.

Where berries mature more or less evenly throughout the year, control measures are harder to devise, and none of outstanding value has been found as yet. Monthly pickings have been recommended as infestations may run very high, entailing losses of 15, 20, or even 30 percent. Parasites have been studied, especially a fungus, *Beauveria bassiana* Vuill., but, though natural infesta-

tions are very helpful and may reduce the insect population considerably, attempts to increase the natural parasitism by spraying spore suspensions have given insufficient results. The fungus is very virulent to insects feeding on unripe berries, and its virulence is further enhanced by the overcast weather prevalent during the months of June and July north of the equator. Beetles have a very curious reaction to infection. Usually the insect will have bored a gallery to the middle of the berry before the infection develops to any considerable extent. It stops feeding then and begins to crawl slowly backwards until its abdomen juts out from the berry. From the abdomen then develops a pinhead puff of white mycelium bearing by the thousands small spores scarcely 3 μ in size.

Hymenopterous parasites are abundant in some parts, principally *Heterospilus coffeicola* Schmied. and *Prorops nasuta* Water., but very little benefit is derived from their parasitism.

Ants, especially *Oecophylla longinoda* var. *annectens* Wlr., *Macromischoides aculeatus* Mayr., and *M. africanum* Mayr., are big nuisances in coffee plantations. *M. africanum* can inflict such painful bites upon humans that high fevers may ensue. Pickers and pruners exposed to these insects are careful to avoid the infested trees, which, abandoned and unpicked, soon become breeding places for the berry-borer. A satisfactory bait is used against *O. longinoda*. A predacious ant controls the others. Known locally as *badeno*, it is harmless to humans. It suffices to transfer a *badeno* nest to an infested tree in order to rid it in no time of all inimical ants.

Stem-borers, mainly the West African coffee borer, *Bixadus sierricola* White, a cerambycid beetle, can do much damage, though in well-kept plantations where sanitary practices are strictly observed, injections of carbon disulphide into the galleries easily keep the beetle under control.

There is on the whole very little fungus parasitism on coffee, though the white root rot may be very troublesome in places. In west-central Congo around Lake Tumba coffee roots are often attacked by a mealybug, *Pseudococcus citri* Risso. This insect does not seem to be dangerous unless *Polyporus coffeae* Wakef. develops on the exudate. Then the mealybug lives in little cells made of *P. coffeae* mycelium. The fungus itself develops to the point of forming a brownish sheath around the roots. Control is easily obtained by exposing the attacked roots to sunlight for five days, which kills off the fungus. Control of the coccid is then obtained by mixing with the soil, in which the roots are buried again, a certain amount of potassium sulfocarbonate. This chemical decomposes in the soil into carbon disulphide and potassium carbonate, the first being active against the mealybug.

Hemileia rust is practically nonexistent on *robusta* and if present is more an indication of unhealthy conditions of the trees than of true parasitism.

With the development of *arabica* coffee on the eastern plateaus need was soon felt to study its diseases and pests. The troubles of *arabica* coffee are much the same as in British East Africa, with the exception of *Pseudococcus kenyae* LeP., and *Antestia* spp. and *Lygus coffeae* China inflict great losses, the former causing internal rots of the berries and the latter inducing flower abortion. In the former case rots are due to the same fungi that produce internal boll rots (stigmatomycosis) of cotton.

Cacao. The cacao tree, unlike coffee, suffers from a great variety of insect pests and fungi. The whole gamut of root rots is to be found. Armillaria root rot is important and causes the well-known collar-crack. But the most destructive pests are to be found among the insects. Special mention goes to *Sahlbergella singularis* Hag., a scourge of the Mayumbe plantations. This mirid bug, puncturing pods and shoots, not only causes extensive fruit-drop but leaves cankerous and ailing trees.

Sprays and dusts are recommended, but planters are reluctant to apply them as great difficulty is experienced with equipment. Cacao is cultivated under the shade of natural forest trees, and this forbids the use of motor-powered sprayers and dusters. The small back-borne sprayers and dusters would require huge gangs of semiskilled labor. Perhaps with the advent of DDT, a cheap, highly toxic, and easily applied dust will fulfill the requirements. DDT might also be

effective against *Helopeltis bergrothi* Reut., which is second in importance, or against *Heliothrips rubrocinctus* Giard, which causes some leaf-drop.

Cinchona. In the eastern plateaus considerable attention has been paid to Cinchona and its pests. Since the occupation of the Dutch East Indies by the Japanese, considerable efforts have been made to develop this crop in order to alleviate the dearth of the drug. Not only has the Belgian Congo now attained self-sufficiency but increasing quantities of quinine are produced for export. Most of the plantations are concentrated around Lake Kivu on the encircling mountain-flanks. At altitudes from 1,700 to 2,200 meters Cinchona is very heavily attacked by *Helopeltis orophila* Ghesq., which is capable of totally destroying young plantations. This insect seems to be much more destructive than its Asian congeners on the same host. To control the pest, pyrethrum dusts have given very good results. The finely ground flowers are mixed with wood ash, finely powdered and perfectly dried, in the proportion of 1 : 3 to 1 : 6. Efforts are made to find resistant clones, if any. Mention must be made also of the honey fungus, *Armillaria mellea* (Vahl.) Quel., which attacks the roots. As it is very troublesome on newly cleared land, the problem might be solved as suggested for Hevea root rots.

Potato. In 1941 and 1942 late blight (*Phytophthora infestans* D.B.), the dreaded potato disease, swept disastrously over Kenya and Uganda and by the end of the latter year got a foothold in Belgian Congo. In 1943 it extended its ravages over the whole of Ruanda-Urundi, the Kivu and Ituri districts, and spread with dire consequences to the native-grown crops. The Administration had introduced the potato as part of a general program of improvement of native agriculture and principally to provide the dense population of the Ruanda-Urundi with a most-needed supplement to their diet. No difficulty at all had been experienced with acceptance of the potato by the natives. In fact, it fell immediately in favor with them. As a result, the potato was widely cultivated and was near to becoming a staple food on a par with beans. This gauges the disaster that the invasion of late blight entailed. It is estimated that 200,000 tons of the potato crop were lost in 1943 in Ruanda-Urundi alone.

Since blight finds suitable environmental conditions in tropical highlands, which have no parallel except in Ireland and in certain districts of the American Atlantic seaboard, the disease is one of the most difficult to control. Bordeaux sprays, which have been standard means of control, have only a limited application under present conditions of native agriculture.

The use of resistant varieties can alone be considered for the time being, but in this we meet one of the most intricate problems of selection applied to disease resistance. A host of workers have tackled the problem in England, Germany, Russia, and America with few outstanding results and at the cost of protracted efforts during many years. Moreover, appearance of local or widespread biotypes of the fungus virulent on formerly resistant strains have impeded selection of universally resistant potato varieties. Knowledge of local biotypes is thus one of the prerequisites for the selection of resistant varieties. Progeny and hybrid selection stumbles in the tropics on a major difficulty. In the tropics short days of eleven to thirteen hours of sunshine prevent, with cultivated varieties of the potato, flowering and seeding, which happens rather freely under temperate climates with longer summer photoperiodicity. Means to by-pass the difficulty are now being studied, and only if it can be solved will selection be possible on an adequate scale. At present a sizable collection of varieties, continually increased as conditions permit, is being tested under blight conditions.

Bacterial rots of tubers have been recorded recently, but, though late blight has been less favored by climatic conditions in the past year, it is suspected that these rots are partly due to a masked epiphytotic of *Phytophthora infestans.* Their prevalence in heavy soils lends support to that assumption.

The foregoing pests and diseases of highland crops are studied by the Mulungu laboratory.

Other Food Crops. Corn, wheat, peanuts, rice, cassava, and sweet potatoes have, of course, an importance of their own, and any

factor that might play havoc with them calls for our diligent attention.

Corn, with its host of varieties, lends itself to widespread cultivation, though in a few regions of the Congo it is unknown or little cultivated. The wide range of climatic conditions prevalent in the Congo accompanies an equally variable scale of pathological problems, but on the whole the foremost diseases and pests are: in the highlands, "streak," a virus, and *Busseola fusca* Fuller, a lepidopterous stem-borer; in the lowlands, *Sclerospora maydis* (Rac.) Palm. Streak, with *Cicadulina mbila* (Naudé) and *Cicadulina* sp. as vectors, has taken year in and year out a steady toll of the crop, especially in the Ituri district. In the same district the stem-borer has exerted considerable damage inasmuch as it finds with two crops a year most suitable breeding conditions.

Sclerospora maydis has been of late prevalent in the Sankuru district, and selection of resistant varieties or strains is in progress. In the same district corn is also subject to a peculiar root disease called *shimbu* by the natives, for which they have superstitions. In this disease are involved a monophlebine coccid, an ant (*Camponotus*?), and a fungus. The pantropical grass weed, *Imperata cylindrica*, is a very active host plant. In fact, the disease is as yet unknown where the weed is not dominant.

As might be expected, wheat is cultivated only in the highlands, and one meets with it an old, unwelcome, and omnipresent acquaintance: "Wheatman's burden," black rust, or *Puccinia graminis* Pers. Though barberry, its only alternate host, is absent in Africa, black rust finds no difficulty in being a scourge and big nuisance, to put it in polite words. Wheat is so appreciated by the natives of the upper highlands that two crops succeed each other at close intervals every year. Stubble and ratoons are bridging hosts that carry over the disease from one crop to another with great ease. Nothing has been done yet in the way of selection for rust resistance, but seeds of resistant East- and South-African varieties have been imported. Leaf-eating ladybird beetles, *Epilachna hirta* Thunbg. and *Epilachna serva* Arr., are the major pests. By skeletonizing the foliage crop yields are reduced. The larvae are sensitive to pyrethrum dust, and efforts are being made to popularize this insecticidal plant for home use.

Rice, cultivated in the hotter districts of the colony, enjoys comparative freedom from diseases and pests. *Helminthosporium oryzae* B de H. can sometimes be troublesome, but the greatest damage is done by birds. Flocks of aggressive and quarrelsome sparrows pluck and suck the seeds in the milky stage. Scarecrows are made of upright branches of *Macrolobium*, whose coarse and thick leaves remain attached after drying. These branches are interconnected by *kekeles* (split vines), and potbellied *mwanas* (children) set them in motion and rustle the leaves by short tugs on the lines. The effectiveness of this contraption differs not a whit from that of scarecrows the world over. The best way to meet the problem is to time planting so that heading of rice and of wild grasses occurs simultaneously. Birds then have two bones to pick instead of one.

Peanuts, cultivated more as a delicacy than as a staple food plant, are apt to be badly infested by "rosette," caused by a virus transmitted by *Aphis laburni* Theob., as researches in Gandajika have shown. Close planting is a means by which infestation can be considerably reduced.

Cassava, on the other hand, is the mainstay of the natives and is even more widely cultivated than corn, but it must be understood that cassava is not as carefully planted and tended as other crops. Planted at the end of rotation intermixed with bananas, it serves not only as a food reserve but as a preparation to fallow. For the former purpose the cassava is admirably suited; roots are dug up at the consumer's fancy over several months. Diseases are relatively unimportant, but they do reach an economic level in places such as Ruanda-Urundi, where the food situation needs careful management. The only economic disease is mosaic, a virus transmitted by *Bemisia gossypiperda* M. & L. var. *mosaicivectura* Ghesq. Among the many varieties of cassava existing in the Congo it should be easy to find some resistant to mosaic.

On sweet potato a sort of "rosette" was discovered in the Ituri in 1939. Though the causal organism has not been determined, a virus is suspected. The sweet-potato weevils, *Cylas puncticollis* Boh. and *Cylas* sp., are

troublesome in some parts, and it is very difficult to control them under conditions of native agriculture.

SUCH are the plant disease and pest problems that are to be coped with in the Belgian Congo. Extending over a wide range of crops and a no less wide range of pests and diseases, much work and research have yet to be undertaken to arrive at a fuller knowledge of them. Some are new and specifically African, though most are pantropical or even universal, but new surroundings and interaction of local conditions cause them to be viewed from unfamiliar angles. A good deal of the work accomplished up to the present has more the character of an inventory or a preliminary weeding out of minor problems than basic research.

The more academic work of fungus and insect collection is far from being neglected. Not only are a mycological herbarium and an insect collection being built up at the central laboratory but much of the collections have gone to national museums and herbaria in Belgium.

Central Africa has an appeal of its own—land of mighty rivers and lakes, of dense forests and sun-scorched savannas precariously situated between huge deserts. Its very nature is a challenge to mankind if these regions are to be called upon to pay their contribution to the world's economics. It will only be able to do so if the existing climax is not thrown off balance. In this rests the challenge. Modern science has given a wealth of knowledge and perfection in tools. It is up to us to muster all available resources to bring to this country wealth and prosperity, to leaven the native peoples into contributing members of mankind. The challenge and the vastness of the problems that confront us, of which plant protection is one of many, call for men conscious of their mission and the path they must tread. This ideal more than repays the many discomforts, petty and big, moral and material, inherent to life under the sun of "Darkest Africa."

Darkest Africa? No more so. "Darkest" is indeed a euphemism, and none but those who have lived and toiled under the sky of Central Africa are fully aware that it is often uncomfortably sunlit and steaming hot.

AN INCIDENT AT AMPFING

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On May 3, 1945, the Third Corps Forward Headquarters found itself in Dorfen, a sleepy little town fifty kilometers almost due east of Munich. For the Third Corps the war was over. The Corps on the flanks had pinched off its zone of operations, which on the transparent overlay of the situation map came to a sharp end point around the Austrian border. The staff was not entirely pleased. "It's a darn shame," murmured a Corps Artillery major as he shook his head at the map. "And just when the war was almost getting to be fun."

Public Health Team Number Two, Third Army, had been attached to the Third Corps for ten days. Public Health Teams are not to be found in the Army Table of Organization, especially when they consist of two officers of the United States Public Health Service, an UNRRA nurse in a British uniform, and one private, AUS, driving a springless reconnaissance-and-command car to which is attached a trailer filled with a half-ton of DDT powder. It was a unit dreamed up by the Third Army and accepted by the Corps because it promised to fulfill a need.

In the past ten days our team had surveyed six towns, reorganized public health departments and hospitals, had been in a dozen camps for displaced persons, deloused several thousand people, and, of course, had written many official-sounding reports. During the same period we had come down from Frankfurt, had driven four or more hours each day over roads of every description, and had set up our meager equipment and personal belongings in three towns in order to keep up with the Corps.

Omar C. Hopkins, Senior Sanitary Engineer of the Public Health Service and Lieutenant Colonel to the Army, was gray-templed, soft-spoken; an expert on sanitation from Oklahoma. I was the medical officer, and the guild rules of medicine placed me in charge of the team despite my lower rank. "Hop," as he was known to everyone, and I were now veterans of many a waterless, foodless camp for displaced persons. We had been sent overseas post-haste when it looked as if the Germans would collapse in September of 1944 and then had sat gnawing our fingernails in the UNRRA office in London for six weeks. A deal was finally made between the Public Health Service and the Army, and we were transferred to General Eisenhower's G5, the branch that had been established for military government and civil affairs. We flew to Versailles and from there were passed down on paper and bodily to the Twelfth Army Group, through the European Civil Affairs Division, and thence to the Third Army. We started to operate the day after we reported to its Public Health Branch.

In the beginning we were almost completely on our own, thumbing rides on courier jeeps and trucks and carrying our few supplies. Three medical officers and two sanitary engineers were supposed to cover the civilian public health activities in the ever-shifting Third Army area. We were attached, detached, transferred, and just sent to more units than we will ever remember. Most of the time all we could do was inspect, evaluate, and report and tackle only the most pressing emergencies. The hospitals and other medical facilities of

the Army had their hands too full with their own problems to have much time for civilians, either allied or enemy.

The understaffed, undersupplied G5 eventually turned over its medical headaches to the Surgeon. Now the medical department could support us and extend some of its seemingly limitless supplies of equipment and personnel to our problems. No one knew definitely "under" whom our team operated—G5 or the Surgeon—so we reported as the spirit moved us and where we thought we could get the most effective action. This loose arrangement had several merits: it allowed most lenient movement and definition of our own problems without too much regard for official channels; and we wrote our own Standard Operational Procedures as we went along. Every morning and evening we visited both G5 and the Surgeon, with the query, "Any problems today?" There always were.

The evening of May 3 we returned to Headquarters after an inspection of the large allied prisoners-of-war camp at Moosberg. Mike, our nearsighted driver, navigated our battle-reconditioned vehicle safely into the parking area once more. Outside Headquarters the sidewalk was crowded with liberated French prisoners waiting for the trucks that would take them to the next center on their journey home. We walked along the dusty cobblestone street past the row of Corps houses and neat little gardens surrounded by grilled iron fences. The invariable first item of business upon return to HQ was to ask for mail. Hop and I made for the house set aside for the Surgeon and his staff, and, since the mailroom never could decide whether we were with G5 or the Surgeon, Doris Gray, the UNRRA nurse, went to cover G5. She was in high favor with the German-accented sergeant who was the factotum of that office.

There had been considerable speculation about Doris when she arrived in the Army zone a few weeks before. Rumor had it that the red globe on her British cap was some sort of Soviet insigne and that the letters UNRRA on the red patch on her left shoulder were a capricious Russian way of writing USSR. Regardless of nationality and affiliation, however, she was a welcome addition to the Corps, especially since the Red Cross girls were usually relegated to Rear Headquarters. Aside from her professional aspects, she was most helpful when we had to deal with full colonels, supply sergeants, and other absolute authorities who were susceptible to the charms of a feminine smile.

Lieutenant Colonel Edward J. Vandercar, chief of the preventive medical section, was our liaison with the Surgeon's office. When we came in Van was carefully polishing a six-inch Luger, his prize souvenir and the envy of the Headquarters staff. He heard our brief report on Moosberg, put away his Luger, and led us to a map. "Tomorrow you better get over to Ampfing," he said. "Reports from Fourteenth Armored say there is a camp there that is worse than Buchenwald."

I dismissed that as an exaggeration. I had been at Buchenwald concentration camp three weeks before, and its incinerators, torture chambers, tanned human skin for lampshades, emaciated corpses piled like cordwood, and the starved, diseased, still living specimens of human degradation were fresh in my memory.

We located Ampfing just west of Mühldorf and traced the thin curve of road leading east from Denting. Then we all walked over to the mess with Van. The mess was on the first floor of the hotel in which we were quartered along with French liaison officers, visiting firemen below the dignity of being entertained by the General, and other personnel that attached itself loosely to the Corps. The

hotel had been cleared of its German residents, but they were always coming back to get potatoes and other food they had secreted under the beds and bureaus.

THE next morning, the four of us started out early in a car loaded with DDT, a few K-rations, a map, and ten hand-operated powder guns. Our military appearance was appreciably reduced by a total lack of weapons and the presence of a nurse who doggedly continued to wear skirts and who did not possess a helmet. I carried a silly leather riding crop inherited from a Nazi bigwig. Its snap had a salutary effect on the reactions of Germans and improved their comprehension of my hundred-word German vocabulary. Hop carried nothing but a notebook. Mike was the only one who had a frayed, dirty red cross on his left sleeve to denote our noncombatant status.

It was a beautiful spring morning; the ground mist was lifting, and the snow-capped Alps were dimly visible on our right. By nine o'clock we were in Ampfing. The war had passed over Ampfing without leaving its usual ugly imprints. Even the warehouses beside the small railroad station appeared intact. Such structures nearly always had gaping holes from artillery fire or showed evidence of looting. We were constantly on the lookout for large buildings that could serve as centers for displaced persons, but there were none in Ampfing.

We knew that there was no military government officer in the town, but it was always possible that some tactical unit had set up an office to act in this capacity. Our battalion and company commanders thought it was interesting work, and it made impressive reading back home when you could tell the folks you were now mayor of a town. The offices would abruptly terminate their functions, however, when hungry displaced persons, interrupted public utilities, and sick and demoralized Germans revealed other, less pleasant, aspects of civil administration during war.

We pulled up to the first intelligent-looking civilian. "Come here!" I growled. He came up to the car; if he was apprehensive he certainly did not show it. I asked him where *Militaerregierung* was and what about the *Bürgermeister*. The German did not know about military government, but the baker was the mayor. He waved his arms to indicate the directions. I asked him where the camps were, labor camps, concentration camps. "In the woods," said the German, "by the factories, all around." Attempts to elicit more specific information with my vocabulary were fruitless.

"O.K., Mike," I said, "let's find the bakery." Following directions, we soon came to it. Outside stood a man in a dirty gray, black-striped suit, the familiar uniform of the concentration camps. Another man in similar dress emerged from the bakery, his arms loaded with large loaves of bread which he dumped into the horse-drawn wagon that was standing by the door.

"Hey, Comrade!" I shouted, using the term that concentration camp inmates universally applied to one another. Both men turned sharply and with one motion jerked their caps off their shaved heads. They stood at attention, stupid smiles on their blank faces. I beckoned them forward and with gestures told them to replace their caps, emphasizing that they need not do that any more, ever. The smaller of the two was summoning up his courage. His lips moved, and on the third attempt he said, "I speak English, sir. May I assist?" The accent was French.

"Show us where the camp is," I said. He crouched on the fender. "Come in; sit down here," I said, pulling him up by his arms. He looked at me with

unbelieving eyes and sat down on the edge of the leather seat. "You tell the driver how to get there." The man jumped off the seat and crouched behind Mike. It was not until much later that I persuaded him to sit with me again.

We started to question him. How many people were there at the camp? About six hundred, but most of them had fled. What were the conditions? Bad, very bad. Any Americans at the camp? No, but an American officer had been there and said there would be help. He drew out a dirty slip of paper. "This authorizes the bearer to draw all necessary supplies for his camp," it read. The signature and serial number were illegible, a normal precaution when handing out such vouchers. Bread—he was getting bread for the camp. Was there any water or electricity at the camp, Hop wanted to know. No, nothing; electricity failed three days ago. Many people dying? Oh, yes, just about the usual number.

I asked our guide his name. "Andre Israel—French," he said and pulled up his sleeve to reveal a tattooed number on his left forearm. This was a camp for Jews, almost all Hungarians. He himself had been there six months and had been appointed a clerk because he spoke German. Was it an extermination camp, gas and incinerator chambers in it? Andre shook his head without changing expression. This camp was established only eight months ago. It was chiefly a stopping point for people who were on their way to Auschwitz (now again called by its Polish name, Oswiecim) where the gas chambers were—for two, or three, or perhaps four million men and women and children. Thousands had passed through here. Andre shrugged his shoulders, and his voice, dulled of all feeling, sounded as if he were talking about sides of beef. Then, two, three months ago, he went on, transportation broke down. They had buried over two thousand since then. Any other camps around here? Yes, about ten, but most of them were labor camps of the Organization Todt. There were two factories, one making explosives, the other cement.

We entered a wood. As in all German forests, the trees were carefully spaced, and the ground was clear of underbrush. A small metal sign on a post read "KL" —*Konzentration Lager*. We drove on. Around a sudden bend in the road, a fifteen-foot, triple barbed-wire enclosure loomed into view. At the top of each corner was a guardhouse equipped with searchlights. A few wooden barracks and several green silo-like structures were scattered under the trees. "Did anyone escape by climbing the trees?" I asked because some of the branches extended over the fence. "Escape?" Andre asked in bewilderment. "To where?"

The area was deserted and silent, and the cry of a bird echoed sharply. Without the barbed wire it would have seemed an idyllic spot for a vacation. Across the road were neat wooden houses, surrounded by a barbed-wire fence. "The guards lived here," said Andre. I felt a rush of anger, remembering Buchenwald. "Did the comrades get many of them?" Andre shrugged his shoulders again, a motion combining ignorance with the feeling that it was of no importance. "They got out fast. Had time to kill only a few comrades, maybe twenty, before they left. Perhaps some are still in the forest."

We stopped, and Andre jumped out of the car, ran to the gate, and shouted some names. Two men came running out of the nearest wooden barrack and drew open the gate. They stood stiffly, caps in hand, as we drove in.

"Who is in charge here?" I asked as we entered the largest barrack. We went into a dispensary, containing a wooden examination table, a few rusty

instruments, a row of ointment jars on a shelf, and a large poster on the wall announcing the louse as an enemy that must be eradicated. "Who is in charge?" I repeated. Andre translated.

"This is one of the doctors," said Andre. A tall, stooped man with an indescribably sad face, his metal-rimmed spectacles hanging loosely on his large nose, stepped forward from the door. "Doctor," I said, "how many sick people do you have here? Can you give me a list? And how many of them need immediate hospitalization?"

"All are sick," replied the doctor through Andre. "Hundred, two hundred. All should be hospitalized."

We asked about food. The cook had a few supplies left, mostly potatoes, and more were on the way. Enough for two or three meals; that is, for a cup of soup for every man. "Do you have any women or children in the camp?" I asked. Yes, there was one.

We were led to the adjoining room. A young woman was arranging a tattered blanket around an infant lying in a wooden crate. "A month old tomorrow," said the doctor. "The first one here who has ever survived that long." The mother and child appeared to be well, and the baby was being breast-fed.

"Surgical cases in here," said the doctor, opening the door to the large room occupying the remainder of the barrack. Here on double-deck wooden beds—mere wooden slabs covered with filthy straw—were gaunt shadows of men with shaved heads, showing their ulcerated legs, the unhealed whiplashes across their backs. They all had pale faces and puffy ankles, the protein-deficient flesh that was unable to recuperate from even minor wounds. Numbers were tattooed on their forearms or across their chests. What infectious diseases do you have here? we asked. Typhus. Are you sure it is spotted typhus and not intestinal typhoid? No way to be sure; probably both. No one with high fever in this ward.

We asked to be shown around, the worst places first, and went out of the barrack. On the ground by the door was a thickset man on his knees, hands folded in prayer, eyes shut. The doctor made rotary motions at his temple. "Crazy," he said. "A Pole, the only one we have here." Mike was breaking open a K-ration box and passing out its contents to two other inmates who had appeared.

Reinforced by four men who clambered onto the running board, we got into the car again. Andre was now more self-possessed and directed Mike through the muddy court. We bumped along between tree stumps and mudholes. "Here," said the doctor. In front of us was a raised knoll with a stovepipe sticking out of the ground. "Bunker," said the doctor.

We made our way on foot through an inch of mud to a hole in the ground. Crude wooden steps led down some eight feet. They were slippery, and our noses were assailed by a fetid smell combining decay, excrement, and sweat. "*Achtung!*" cried a voice. There was a moment of silence, and then a hoarse roar arose, an inhuman, unearthly sound. "America — hooray — hooray —" A dead, muffled, hopeless sound. "*Achtung!*" cried a voice again, louder. "No, no," I snapped. "No more! At ease!"

On both sides of a rectangular space were triple shelves, bare wooden planks. In the center, three wooden poles supported the ceiling. At the far end a nude skeleton sat on a barrel with a plank across it. He was supported by another skeleton who was standing; rather, they leaned against each other in order not to fall down. Bloody excrement was spattered around the barrel. We walked along the planks on the muddy floor. The shelves were filled with what had been men. Their bodies

were naked or only partly covered by a scrap of tattered, dirty, gray blanket. Their bodies were no more than skin stretched over bone; their knees were the thickest portion of their legs. Their shaved heads hung limply, eyes staring out of hollow sockets, noses abnormally prominent against the fleshless faces. Mouths were open, dry, red. Expressionless, animal-like creatures, they all looked alike; all individuality had long ago been washed out. Some had enough strength to turn their heads and followed us with burning eyes; a few turned over and extended their hands in our direction; some just lay, staring with unseeing eyes and barely breathing.

A soft, deep groan, a murmur of death issued from one of the bodies. "*Wasser, Wasser, bitte,*" the boy whispered. I felt his head; it was burning hot. A man who was standing stiffly at attention at the table in the center, a crude metal pitcher in his hand, did not move. He was the only one with clothes on.

What was there to say? "We shall help," I croaked. "We shall help as soon as we can." The tension broke. There was the inhuman whine once more, "*Hilfe, hilfe—*"

I turned around and made my way to the stairs. I found a look of ill-disguised nausea, disbelief, and anger on the faces of Doris and Hop, the same expression that must have been on mine. Mike stood on the steps, rigid and with a quivering lip; he looked at me with compressed mouth and swore.

We entered four more bunkers and two corrugated iron shacks. The shelf beds were arranged a bit differently, and one iron shack had one thin blanket per man. Some of the men were not quite so emaciated; others had great sores on their legs and backs. A few that stirred around, stumbling between the central table and the bunks, had ankles swollen with edema. It was more and more of the same. "We shall help, we shall help as soon as possible." If there was hope in their replies, I could not detect it, but none complained.

"How many of these men?" I asked the doctor, waving my arm to encompass the area. He passed his hand over his forehead and adjusted his glasses. "It is hard to think," he muttered. He turned to a comrade. "Get every bunker to count the patients at once!" He spoke in loud, harsh tones. He did not mean to be cruel, but it was the only way to get a response from these beaten, dulled people.

Hop pointed to one of the half-dozen silo-like structures, each perhaps twenty feet in diameter, covered with a thatched roof. "What are those?" We were led to one by Andre. A small door, no windows, straw covering the floor. "The healthy ones slept in here," said our guide, "Fifty in each. Didn't stay healthy long. Some of us escaped the guards when they left by hiding in the straw." "All empty now?" I asked. "Yes, all that could walk have left."

We held a hurried conference. The doctor came up with the information that there were about 150 men in the bunkers. I asked how many doctors there were among the inmates. "Eleven," he said in a flat voice. "At one time there were over seventy. Many of the eleven are sick themselves. I am sick—" His voice faltered. Andre continued. "Many lawyers, actors, doctors in here. Almost all Jewish, Hungarian. No other Jews left."

Immediate hospitalization was essential for all. We thought that at best no more than half the people could possibly survive. In large concentration camps such as Buchenwald, where twenty thousand inmates were discovered, whole evacuation hospitals had been sent in to take over the rescue work. The numbers here were too low for such action, and the delays would be too long. We decided that we could handle the

organization phase ourselves. Hop and Doris would stay at the camp, delouse the population, and get them ready to be moved. I would go back and arrange for hospitalization and ambulances.

Mike unpacked a box of DDT cans and our ten hand guns. These consisted of a tin can attached to a hand-operated pump. The DDT powder was placed in the can, and a group of likely-looking individuals of a camp to be deloused were instructed in the gun's use. Clothing was loosened, and two squirts of the gun were directed down the front of the neck, the back of the neck, up each sleeve, and down the trouser or shirt belt, fore and aft; cap or hair was also powdered. This method effectively controlled insect life, did not entail undressing, and could be done rapidly. It was the main means of combating typhus in Europe. For the naked inmates of this camp, it would be necessary to dust thoroughly both their bodies and their ragged blankets.

Hop asked the doctor if he was sure that 150 people were all he had. The doctor bobbed his head up and down as Hop slipped a couple of K-rations into his coat pocket. Another English-speaking man was found so that Andre could accompany me back to Ampfing.

The car had sunk down in the mud, and we had some trouble getting under way. Andre sat in front with Mike, shaking his head in refusal when I invited him to the back seat. I asked him about big buildings in the area. There was a labor office at Ampfing—the *Organisation Todt* Bureau—and a school at Mühldorf. He thought there was a hospital at Mühldorf, too. Did he know of any *Wehrmacht* food or supply depots in this area? No, he did not think there were any. What about clothing and beds? The school at Mühldorf had been converted into barracks and had plenty of good beds, but he did not know about clothes. Any water or electricity there? He did not know but he understood that the building had been hit by a bomb.

We returned to Ampfing and were directed to the O.T. Bureau. It was a one-story building of two wings leading from a central reception hall. The wings were divided into rooms filled with desks and other office furniture. There was only one flush toilet, but there were several hand sinks; a weak trickle of water came from the faucets. The electric current was off. An adjoining building had a large kitchen with wood-burning ranges and the inevitable 600-liter German soup kettles.

I was covering the buildings with rapid strides, mentally placing the patients, beds, and medical equipment. A German in the mustard-yellow uniform of the Todt labor corps attached himself to us, running ahead, opening doors. He opened his mouth several times to ask me something, thought better of it, and screwed up his face in a quizzical expression.

The O.T. building was suitable and could house 150 people with some crowding. I turned to the German. "Are you in charge here?" I barked, and Andre translated. "Good. Then in two hours I want every piece of furniture out of this building and all the rooms swept and clean. Leave only the beds, if you have any, and one chair in each room. I shall order the mayor to furnish help, but it is your responsibility." The German snapped to attention and began to speak rapidly to Andre. "He wants to know if he can stay here. He has one small room." "Tell him we are bringing typhus patients in here and to get out in two hours but only after the work is done." The German's face responded to the word *Fleksfeber* (typhus), and he did an about-face.

Mike drove back to the bakery and we entered its warm, yeasty atmosphere. An ample woman met us, wiping her hands on an apron. I demanded the

mayor, and he emerged from a back room. "All right," I said, backing him up against the wall, "now listen. Get fifty strong people, anybody, and get them to work at once. You know the O.T. Bureau? Good. Clean it up, all furniture out. We are bringing concentration camp people in there, typhus, starved. Get fifty women and have each one bring a pail of hot water, soap, washcloths, and towels. These women are to wash up the poor people. Get food: chicken or meat broth, mashed potatoes, little bread, enough for 150 people. The women are to prepare 150 meals in the kitchen. Have them bring cups, plates, knives, forks, and spoons. All this must be done by two o'clock, three hours from now."

The mayor looked a bit dazed and counted on his fingers. "Fifty people, food for 150, soap, towels—what are we to do with the furniture?"

"Throw it out of the windows, anything. There is a court in back of the building. Stack it up there. I want it neat. You know the penalty if all this is not done?" The baker gulped and tugged at his collar. "It is hard, very hard." I looked as ferocious as I could and snapped my riding crop against my shoe. "At once!" The mayor edged himself away from the wall and ran out of the door. I could hear his voice summoning someone.

"Now," I said to Andre, "are you sure about those beds?" "Oh, yes," said my guide, "unless they have been destroyed." "You stay here and keep the mayor on his toes—you understand. see that he does everything that I ordered. I'm going for ambulances; and trucks to get those beds. I'll be back in about two hours." I had my fingers crossed at this point.

Back in Dorfen I gave Van a summary of our findings. "We need a medical unit in there, ambulances, and hospital rations." Van thought for a moment. "Blood plasma," he said, "vitamins—" "Food and care," I said. "And every hour means literally another life."

Van picked up the telephone. "How many ambulances can you get along with?" he asked. "About a half dozen, and a couple of trucks." I was using estimates that were a carry-over from the early, skimpy G5 days. Van reached the 187th Medical Battalion and in less than twenty minutes arranged for a platoon of the 662nd Clearing Company to take over the treatment of the concentration camp patients; seven ambulances and two trucks; rations and medical supplies. This was almost too good to be true.

In less than an hour Mike and I were out on the highway where the medical battalion was bivouacked; ambulances and trucks were lined up in readiness on the field. I outlined my plan to the officer in charge. We would return to Ampfing, I would proceed to Mühldorf with the trucks to pick up the beds, and the ambulances and a guide would start for the camp a half hour later. Several trips would be required to evacuate all the people. The medical platoon would arrange reception at Ampfing.

When we returned the O.T. Bureau was a beehive of activity. Most of the furniture had been stacked up in the court, and numerous papers, forms, and books were lying around in the halls. I could almost hear the yelps of complaint from some intelligence officer as he surveyed the damaged records, many of which were already burning merrily in the court; I ordered the rest deposited in a room over the kitchen. Women were scrubbing floors, and children were running about. Some American soldiers had drifted in, adding to the confusion and the mayor came running, asking what the time was. I ordered everyone out but the actual workers. The kitchen

was also buzzing with activity. Kettles were steaming, and all the utensils were sparkling bright. Cups, plates, and the cutlery were in neat array on the tables. Andre and his friend from the bakery were sitting in one corner, munching huge crusts of bread.

"You think we could stay here, sir?" Andre asked, "There are rooms above the kitchen—" "Sure," I said, "you'll be needed. But now let's get those beds. And your friend can show the ambulances the way to the camp."

We drove off, the two trucks following. On the right was a bluff with a cathedral and some large buildings overlooking the river. "Ecksberg Convent," said Andre. I filed the information in my head. We were not supposed to disturb religious installations, but often the Germans had already converted them to other purposes, and it was then assumed that their use was not prohibited. Mühldorf appeared suddenly as we emerged on the other side of a bridge. The north section of the town was badly beaten up. The streets were empty, but as we drove along, people began to come out, and suddenly the streets were filled. The town was still under daylight curfew.

I told Mike to stop, and Andre called out to the Germans to assemble. They came forward hesitatingly. Andre translated that I wanted ten men to climb up on the trucks to help me load things for about a half hour. There were no volunteers, so I pointed to the huskiest specimens and ordered them on the trucks. None was below forty years of age. The towns of Germany had long since been drained of younger manpower.

The school was a few blocks to the right and consisted of two stone buildings. One had been converted into barracks, and a gaping hole in the roof showed where a bomb had penetrated three stories of the building. It must have been a faulty explosive because the walls were still standing. Rain had increased the damage, and much of the plaster was on the floor or ready to drop. The place was filled with cumbersome double-decker wooden beds with gunny sacks stuffed with straw as bedding. A few of these beds would fill our trucks, and not many of our patients would be able to climb to the upper decks. The straw-filled bags, however, would serve as mattresses. I ordered 160 of them to be loaded and told the drivers to see that only clean, unworn ones were taken. The Germans went to work.

I decided to explore the other building. The door was unlocked, and Andre and I entered a number of schoolrooms, with desks, blackboards, and other paraphernalia. Behind the teachers' desks were Nazi flags and pictures of Hitler. On the second floor was an office and a small apartment. The bed had been occupied recently, and butts of American cigarettes were scattered on the floor. Some of the butts were stained with lipstick. A civilian suit was hanging on a hook. "Why don't you put this on and discard your outfit?" I asked Andre. He looked at the suit and tried on the coat. "If you don't mind, Major, if you please," he said, "may I keep my clothes? This coat is warm and I could use it, though." The concentration camp uniform had become a badge of honor and survival and was usually retained by the liberated inmates as they wandered over the roads of Germany.

The trucks were now loaded with the straw mattresses, and I dismissed the sweating Germans. We headed back to Ampfing.

The ambulances had already left. "Mike," I said, "you get yourself a handful of Germans and get these mattresses into the hospital. You'll have to put five or six in each room—and see that the rooms are clean." Mike jumped to his task.

Trucks and jeeps began to draw up at the gate. The personnel of the medical platoon selected one room for treatment and dressings, another one for an office, and began to unload their medical supplies. It was certainly not what a hospital should have been, but it was the best we could do.

The work was not completed before the ambulances returned. The faces of the drivers were grim. As the first few stretchers appeared, some passing American soldiers and Germans stopped and watched silently from a distance. Only a few of the patients were on stretchers; the rest had been packed in sitting, eight to each ambulance. They began to come out. Men without clothing, without hair, without flesh, sores on their legs, their knees larger in girth than their thighs, a filthy piece of blanket around their groins. They stumbled and fell as they tried to navigate the three steps into the place before someone could help them. They shuffled a few steps forward and rested, exhausted, and looked around in wonder. A gasp came from the onlookers. The Americans swore.

The German women wrung their hands. "*Mein Gott, Mein Gott!*" they moaned, and it was not an act. Two women who had been cleaning up the hall stood transfixed. "How can it be?" they cried and dropped their brooms to help a stumbling Jew. Mike rushed forward. "Hitler's work. You ought to be proud of it!" he yelled at the women in English. I told him to help place the patients.

The macabre procession continued. It included some men in relatively better condition, dressed in striped suits, who introduced themselves as doctors. Doris emerged from the last ambulance. "We miscounted," she said. "They thought we meant just what they call the hospital camp. In the next compound there are about as many, although not as bad as these." I told the sergeant in charge of the ambulance crew to inform Colonel Hopkins that no more than 150 could be accommodated here and that we would have to leave the rest until new facilities could be established. The cook and half of the doctors were to be left at the camp, along with all available food.

"And I have brought the woman with the child," said Doris. I caught sight of the mayor's coattails and yelled for him and for Andre. "See that woman?" I said, pointing to the ambulance by which she stood. "She is to be taken in by your best family in town. She will be given a room, clothing, and rations. A layette for the child. They will be your direct responsibility. And if they are not treated better than an *Obergruppenleiter*. . . ." I snapped my riding crop. The mayor wiped his brow. "Ya, ya," he said, "it will be done immediately." He ran down the steps, talked to the woman, pointed back at me, and they disappeared up the street.

A patient shuffled across the hall. Starvation and disease had washed out all individuality. This skeleton was tiny, a boy that could not have been over fifteen years old. He stumbled up to Doris, dropped on his knees, and grasped her hands. "*Danke, danke,*" he sobbed, kissing her hands. A medical corps man led him off.

Another stretcher was entering the door. The man on it was not breathing. A thin line of bloody saliva had dried around the drooping corner of his mouth; on his face was a look of peace and hope, set in death. "Where do you want the body?" asked the stretcher bearers. They put him against the wall in the hall and covered him with a blanket.

The hospital was now starting to function, and the medical platoon was taking over. A Hungarian doctor was directing cases with obvious fever to the isolation rooms; a clerk in a striped suit was attempting to get the names; the Ger-

man women without further direction, disbelief in their eyes, were starting to wash up the tortured bodies. Out of the kitchen other women were carrying big trays and caldrons of food. I stopped them. "A cup of soup, a spoon of mashed potatoes, a small slice of bread only," I said. These men needed fluid, glucose in their veins, more than anything else.

I went into the room set aside as the office. Andre and another comrade were arranging some papers. Andre had picked up a typewriter somewhere. "I have some records," he said, "the list of the guards. I tried to keep the names of the people in the camp, but that is incomplete. Mostly we had just numbers." I took the list of the guards and thumbed through the pages. Most of the names were Hungarian. "Good," I said, "I'll see that this gets into proper hands."

"This is my comrade," said Andre. "He would like to stay here, too." The man was very short and stocky; his face was chalky, his hair almost pure white. "I am from Budapest," he said slowly in German. "I am a writer, thirty years old. I thank you. My wife is in London. Is there any way of writing to her?" He looked up at me beseechingly and repeated his statement word for word in the same monotonous tone. "You will have to refer to the medical officer, the captain who will be in charge. Perhaps he will have something for you to do." Once more the man repeated his speech. I knew there was no way at the moment for the man to reach his wife. "Look," I said, "supposing you write a note, and I shall see what I can do. Perhaps the Red Cross—" The man felt on the table for a piece of paper, grabbed a pencil, and poised it over the sheet. He shook his head and suddenly started to cry. "I can't remember her name or her address. For two years all I have done is repeat her name and address and now I can't remember. Please wait, please—" I sat down to study the list of guards and waited. Finally I left him with his grief.

The ambulances were now pulling up at the gate with the second load of patients. Some soldiers wandered in and had to be cleared out. A chaplain ran up the steps. "What horror," he exclaimed, "how terrible! Major, how can you stand it? What can I do?" There was no obvious reply to all this, so I let him stand and look at the starved patients as they stumbled or were led through the hall. Finally he murmured something about starting religious services, and ran bouncingly down the steps.

Hop arrived with the last ambulance of the third trip. His clothes were chalky with DDT powder, his shoes were muddy, and his face lined with fatigue. It had been a hard decision to leave some of the people at the camp. The cook had complained that there was no discipline any more. There was enough food for another day or two, and Hop had arranged to have the delivery of water continued by horse-drawn tank. He inspected our improvised hospital and went out with Andre to see the mayor about restoring the water supply and the electricity.

Doris came running. "Those German women are going to kill them. Did you see what they were feeding them?" Instead of a little broth and potatoes, the women were ladling out heaps of mashed potatoes, huge pieces of boiled meat, and slices of gray bread at least two inches thick. When the plates could hold no more, they served them to the men who had been washed up or passed them to the clutching hands of naked men who had stumbled and shoved their way to the food. Those who could sit up or stand were gulping the food like ravenous beasts. And those too weak to stand or sit were being fed by spoon. It was

useless to intervene now; we would have a riot to quell. All I could do was to order the portions cut. I fully anticipated mortality from this unorthodox method of treating starvation. Next day, however, we learned that except for a few cases of vomiting no untoward effects had been noted.

There was little else for us to do. The medical platoon was now in charge. They had set up the treatment room and were starting to examine methodically each patient, to establish a diagnosis, and to start therapy. The administrative officer was making out his list of needed supplies, and the residence across the street was being converted into quarters for the staff. The moribund men had been started on intravenous glucose infusions.

We assembled the five concentration camp doctors who had come with the ambulances and introduced them to the officers of the medical platoon The doctors were instructed to stay and to assist in all possible ways. I promised to keep headquarters stimulated on supplies and hospital rations. We shook hands all around; the doctors in the striped suits looked proud and determined.

Next day the change in the patients at Ampfing was almost unbelievable. The medical platoon had worked all night. All the cases had been seen, examined, and recorded, including twelve cases of presumptive typhus; sulfa and other drugs were controlling the diarrheas; and only one man had died. The pinched faces of the patients were relaxed, and many of the men were sitting up on their straw mattresses holding a piece of brown paper with granulated sugar on it. They had requested that this wonderful confection not be put on the cereal they had for breakfast and instead they were now eating it granule by granule. "The first in a year, the first in a year," they repeated, smacking their lips. German women were scrubbing the floor. One crouched in front of a patient who was describing his previous activities as a lawyer and lecturing on the sins of the Germans, waving a long finger under her nose.

RUMOR from the usual unreliable sources now had it that the war would soon be over. The radio was full of news of German Army groups surrendering, of German units fleeing from the Russians, of more contacts between American and Russian armies, of advances, final thrusts. We were too busy to notice. During the following few days we evacuated another concentration camp, set up another hospital at the Ecksberg Convent, inspected the labor camps in the area, and reviewed the civilian medical facilities at Mühldorf.

On May 8 there were speeches and announcements. It was the official V–E Day, but in Dorfen it was just another day. Trucks rumbled over the dusty roads, soldiers stood their formations. displaced persons wandered through the streets, and German soldiers filled the POW enclosures to overflowing. The German civilians still looked dazed and servile.

It was not until Churchill's stentorian "Advance, Brittania!" came over the air that Public Health Team Number Two caught some of the spirit of the occasion; we toasted the victory with the last of our whiskey. Two slightly inebriated soldiers on the steps below were singing "White Christmas" to the accompaniment of a liberated accordian when we finally went to bed. Before I could go to sleep that night, I saw gaunt men in striped suits on the roads, in camps for displaced persons, slowly making their way home. But they had no home. The road for them had just begun.

CLIMATE AS A NATURAL RESOURCE

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THE climate is part of the natural endowment of a country. In some regions it imposes hardships on the inhabitants, in others it makes life easy. Designs of living adapted to the climate of each region are the results of the accumulated experience of generations. They find their foremost expression in clothing, housing, and agriculture.

At present the outdoor climate cannot be changed, except on the smallest scale. This is axiomatic, and hence life has to be a continuous compromise with the climatic environment. But only in the regions of extremes is climate an implacable foe; elsewhere it is a friendly element that requires only to be understood in order to become useful. A country as large as the United States harbors a great variety of climates. They constitute, if properly exploited, a very important natural resource.

In contrast to mineral resources, climate is inexhaustible. Year after year the single weather events follow each other in unending procession and collectively make up our climate. While the individual day-by-day weather conditions are proverbially fickle, the climate remains fairly constant, at least within a human lifetime. This fact makes it possible to treat climate as a calculable risk. Wherever climatic conditions are adequately known and described, they can be intelligently integrated into plans for all kinds of human activity.

Good administration of an estate starts with the knowledge of assets and liabilities; therefore a comprehensive inventory is the prerequisite for proper use of climate. In the United States the survey of the climate is one of the official functions of the U. S. Weather Bureau. A network of stations observing the weather daily and hourly, manned by professional observers, spreads all over the country. This network provides the necessary data for daily weather forecasts and for the protection of our airways. Climatic information is just a by-product of these activities.

Exclusively serving climatological needs are the data collected by over 4,000 voluntary observers. They constitute one of the least recognized yet one of the most important mainstays of the climatic service of the country. Without the readings taken faithfully every day for decades by these enthusiastic amateur weather observers, the nation would have a most incomplete knowledge of its climatic resources.

For special purposes, climatic stations are also maintained by organizations outside of the Weather Bureau; for example, the Army and Navy, the U. S. and State Forest Services, the Soil Conservation Service, the Bureau of Reclamation, the Tennessee Valley Authority, colleges and universities, agricultural experiment stations, and numerous private power companies. According to a rough estimate, climatological data are collected at about 8,000 localities throughout the country. Impressive as this figure may seem, there are still hundreds of square miles without even a single rain gauge. Moreover, most of the existing stations provide only readings of precipitation and temperature. Wind, humidity, evaporation, duration and intensity of radiant energy from sun and sky are regularly observed only at the main Weather Bureau stations. For many practical purposes an urgent need for more climatic stations still exists.

In spite of this inadequacy much can be done with the data now available, although a serious handicap is posed by the fact that there is no central depository for *all* climatic observations that are being collected. To the Weather Bureau flow regularly only the data from its own stations and cooperative observers. A most definite need exists for a comprehensive directory of all climatic stations in the country and a central archive for all current and past observations.

An even more serious deficiency is the lack of organic statistical treatment of the data. Many observations, after they have served the hour-by-hour needs of aviation and the day-by-day needs of the weather forecaster, are simply filed. They constitute only a *potential* source of further information. They should be summarized and analyzed. The latest publication of comparative summaries for rainfall and temperature observations at Weather Bureau stations dates back to 1930. Since that time up-to-date statistics of climatic series in published form have been available for only a little over 100 localities for each year. This is most regrettable because a census of climate is as valuable a source of information as a census of population. Industry, trade, and agriculture use the census figures published every ten years to great advantage. These same interests could derive as much benefit from regularly published climatological statistics.

Because many consider climatic data as rather intangible information, considerable reluctance exists to spend money on an analysis of what seems to be "past history." To this, one has to add criticism of the inefficient methods in handling the data, which in the past were mostly laboriously compiled by hand. This is a tedious process that consumes many hundred thousands of man-hours and often provides statistics that are not yet in a practically useful form. For years the employment of laborsaving and flexible machine methods of compiling these statistics has been advocated.

In that procedure each climatic observation is punched on a record card, and tabulating machines do the rest. Foreign governments such as those of Czechoslovakia, England, Germany, and Holland have long treated part or all of their climatic data in that fashion. In the United States before the war only a few limited compilations of that type were made as WPA projects. The exigencies of the big conflict saw some remarkable expansions in machine analysis of climatic data. Information on atmospheric conditions in all parts of the world was needed for purposes of military planning. The weather services of the armed forces jointly with the Weather Bureau embarked on an extensive punch-card program and established an archive of millions of observations, mostly from foreign regions. There are plans to keep punch-card records in the future for at least a small network of key stations in the United States. But for the vast store of data now buried in the files, covering at many places fifty or more years of observations, the modern methods of statistical treatment remain only a dream.

The question arises immediately: Are climatic data only useful enough during wars to warrant expenditures for efficient summarization? Is climate an important piece of intelligence only in the grim business of killing people in the most efficient manner? The answer is an emphatic *No!* Then why are the wartime experiences not translated on a large scale for peacetime purposes? The reason is that many have only the vaguest notions how climatic information could be used. We shall attempt to outline a few applications of climatic information to everyday problems.

HOUSING presents one of the most

pressing needs of the nation in the post-war era. It is quite obvious that we build houses to protect ourselves from the exigencies of climate. We build them to have a comfortable year-round habitat. We have a fairly good idea under what conditions we are comfortable indoors; for example, maintenance of a temperature reasonably close to 70° F. and a humidity of around 50 to 60 percent. Further, we want houses that are waterproof and able to withstand occasional gales; roofs strong enough to hold up under the maximal expected snow load; we want water pipes laid deep enough to prevent their freezing and storm sewers big enough to prevent flooding. In order to be able to put up a structure that will fulfill all these conditions we have to know as much as possible about the atmospheric conditions at the homesite. If climatic information is neglected we may build inadequately and will have to pay excessive amounts for maintenance or even face, at times, catastrophic damages. On the other hand, we may build an excessive factor of safety into the house and thus raise the initial cost of building. Either mistake is expensive and could be avoided by intelligent use of climatic information.

The available climatic observations are adequate to enable an experienced climatologist to answer most of the pertinent questions of architects and engineers. The most important gap in our knowledge is the lack of data on the intensity of solar radiation. Observations from about 20 poorly distributed stations in the United States are insufficient to evaluate the radiation factor as an additional source of heat for modern structures using new materials such as glass bricks. This calls for an expanded network of stations measuring solar intensities.

For estimating heating requirements of houses wind data are also of fundamental importance. At present, generally, temperature conditions alone enter into the basic design values of houses. Yet a very low temperature, say, 0° F. under calm conditions, will not require more heating of a house than the much higher temperature of 32° F. accompanied by a wind of 20 miles per hour. If frequency tables of winds associated with various temperatures were available, planning for heat requirements of houses could be materially improved. Closer cooperation between designers and climatologists in the future would undoubtedly result in better basic construction of homes.

Climatic data also ought to find more consideration in the erection of buildings for special purposes such as hospitals. Certain types of atmospheric environment are definitely undesirable for sick persons: prevalence of fog, lack of sunshine, strong winds, and wide ranges of temperature. In that respect it should be demanded that thorough climatic surveys precede the selection of hospital sites.

In the interest of national economy the use of climatic data for the planning of airports is also imperative. For the present, in spite of all the advances made in the use of modern electronic devices, safety and economy of aviation still depend on atmospheric conditions. The proper layout of runways is intimately related to the winds prevailing at the site for the airport and especially the relations of winds to blind flying conditions caused by low ceiling and poor visibility. If these factors are considered during construction, the runways can be built properly from the outset and later expensive corrections can be avoided.

When new airfields are planned a number of sites may be equally advantageous from the point of view of accessibility to cities, availability and suitability of land, drainage conditions, etc. The final choice among the alternatives should be made on the basis of climatic data. A

good airport ought to have the smallest possible number of climatic hazards. These may vary considerably even over a small area. Improper choice can make it more difficult to maintain regular schedules, and a site only a few miles away might be climatically vastly superior.

Also, in the routing of flights, due regard to regional climatology can lead to avoiding zones of cloud-shrouded mountains and their hazards as well as zones of habitual atmospheric turbulence with their ill effect on passenger comfort. Economic considerations, especially on long-distance flights, dictate the use of climatic data on upper winds for the planning of routes. This leads to reduced gas consumption and helps to maintain optimum flying hours.

Aviation and weather science have grown up together. Past experience shows that all those concerned with air traffic make large-scale use of information about the atmosphere. Unfortunately, there is much less liaison between other traffic interests and the sources of climatic information. However, national plans for the immediate future, especially in the field of highway construction, raise a good many problems related to climate. The ideal of the highway engineers is the "all-weather" highway, modeled after the pioneering prototype, the Pennsylvania Turnpike. In the mountains of the colder regions of the country the distribution of snowfall is one of the most important considerations in highway construction. From valley to valley that element varies considerably. Climatic data can outline the optimal conditions for such "all-weather" highways. In addition, important basic data for proper drainage and bridge construction can be made available to the highway engineer. The proper appraisal of climatic factors in highway construction can save millions of dollars annually in maintenance expenses.

We need to place little emphasis on the use of climatic data in connection with dam construction and flood control measures. Sad experience has taught the responsible agencies the value of this information. This cooperation has been mutually beneficial for the engineers and the climatologists because it has led to the establishment of many new climatic stations and snow survey courses in mountainous regions where the climatic network had been inadequate. The limit of the desirable has not yet been reached because beyond the problems of flood control water supply questions are of vital interest in some parts of the country. In the arid and semiarid regions irrigation for agricultural purposes sets off thriving areas from desolate desert. The available water supply from precipitation governs the size of the area that can be adequately irrigated, and, while reservoirs equalize to some extent the variations from season to season and year to year, the basic plan for irrigation projects has to be predicated upon the normal climatic pattern.

In the over-all picture of national economy the planned use of water resources is still lagging far behind the possibilities. It is one of the few fields where engineering can contribute toward an amelioration of local climatic conditions. The planned use of rainfall also constitutes living on the annual "income" rather than tapping the capital—that is, the often irreplacable resources of lake and ground-water supplies.

The exploitation of climatic "income" has also spread in another direction. We refer to the use of wind for power production. Of course there is nothing new about this. In the windswept areas of Holland windmills have for centuries added their picturesque silhouettes to the landscape. Farmers in this country too, in the days before rural electrification became a reality, used wind motors for pumping water. But only in the past

decade have schemes for commercial power production by wind engaged the planners of public utilities. Such projects present difficult engineering problems. The wind at most localities is quite variable in direction and intensity. Economical power production, however, is based on maintaining proper levels for the fluctuating load requirements. To adjust the variable wind to the variable load is so complicated that many engineers have rejected the scheme as impractical. Some localities, however, offer very attractive opportunities. This is proved by the experimental installations of some power companies in New England where extensive preliminary climatic investigations were conducted.

Even in the coming age of atomic power it will be necessary for mankind to look toward living on an inexhaustible "income" rather than on the valuable "capital" of limited mineral resources. The use of such "climatic income" as wind, rainfall, and solar radiation warrants much larger initial investments because the requirements for recurrent expenditures for supplies will be much lower than in conventional engineering plants.

In terms of long-range planning agriculture is likely to be the branch of the national economy that can make the most profitable use of climatological information. The majority of crop plants are sensitive to climatic conditions. Selective breeding has extended the limits within which certain plants will be able to exist, but yields still are mainly subject to climatic factors. In a country where a surplus of many crops is produced climate-resistant plants are much less essential than in countries with marginal agricultural opportunities. In the United States with her variety of climates nearly all essential crops can be grown domestically with the exception of certain strictly tropical products. The problem, therefore, is not one of obtaining a crop but one of the most effective land utilization, that is, of raising profitable crops instead of overproduction of certain staples. And this question of substitute crops is largely one of a climatological nature.

Equally important for the national economy is the question of climatic risks in agriculture. It is an inherent attribute of climate that it includes all the atmospheric variations taking place over a period of time. That means the year-to-year fluctuations of temperature, rainfall, and other climatic elements are part of the over-all climatic picture. It often happens that during an individual year lack of rainfall leads to serious crop failures in an area otherwise well suited for the particular type of crop. On the other hand, in a year with rainfall much above the normal certain crops can be grown in regions where the usual atmospheric conditions are adverse. These exceptional conditions may persist for several years in succession. In the past, transitory improvement in weather conditions has led to agricultural expansion into submarginal regions, but initial successes were followed by disastrous failures when the climatic factors swung back to normal or to the opposite extreme. Seasonal weather forecasts may perhaps one day permit anticipation of such conditions. Then, and only then, can the farmer safely utilize submarginal areas in good years and refrain from planting in years of anticipated poor conditions. At present we are still a long distance from this goal. In the meantime climatic records offer the only reliable guide.

The climatic stations with a long record reveal how many years in the past were good and how many were poor for a given crop. There is no scientific reason to believe that our climate will change radically in the next few decades; hence we can safely accept the past performance as an adequate guide for the

future. Good and poor years will occur with approximately the same frequency as heretofore.

The ideal is to raise various types of crops in the most favorable climatic environment with the least risk over longer periods of time. This can be achieved if climate is incorporated into agricultural planning, on the basis of actuarial appraisal, on an equal footing with economical factors and considerations of soil conservation.

So far we have mainly dealt with necessities of life in terms of shelter, transportation, power, and food. To these we should add recreation as an important balancing element in our lives. The attention of the climatologist in that respect will be focused on problems of resort climate. It is the question of *when* to go *where* for your vacation. Special interests have overadvertised the climatic advantages of certain regions of the country, but elsewhere the climate has not yet been recognized as a valuable source of revenue from tourists.

A country-wide appraisal of the various climates for recreation purposes, by objective evaluation of the facts, has yet to be made. European resorts have studied this factor for years. A whole science, which is a branch of balneology, is built around the study of effective use of the climatic environment for the healing of disease and the relaxation of vacationists. The benefits and contraindications of various climates have been investigated. Climates beneficial for respiratory diseases, nervous disorders, and circulatory troubles have been determined. There were times in the past when it was fashionable for people seeking relief from chronic illness to go to Europe for cures. Fortunately for the multitude that cannot afford such trips, the North American area offers in fact a wider variety of climates than Europe. There are localities in this country which have climates comparable to those of the most famous resorts in Switzerland or on the Riviera. In many cases the only difference is that nobody has written learned papers about those located in the United States. In the interest of the health of those needing climatic therapy the opportunities offered by our domestic climates should be exploited. If climatologists and physicians would cooperate to make use of the available climatic information for this purpose a great deal of suffering could be alleviated.

For the others who enjoy unimpaired health we can use climatic facts to make their vacations more enjoyable. Tourist guides often contain nothing more about the climate than catch phrases. What is needed is factual material on local climatic conditions as related, for example, to clothing for various seasons. Many a trip could have been more enjoyable had the participants been properly prepared for the climatic conditions.

A few attempts to survey the climate for the purposes of recreation have been made, mainly in connection with winter sports. Maps showing the duration of snow covers in some of the prominent winter-sports resorts have been prepared and help to reduce the risk for the planning of contests. But in that respect, too, more remains to be done.

Let us say in conclusion that the unlimited climatic resources of the United States still await exploration and exploitation; they wait to be tapped. They promise full returns by better adjustment of our homes and health, our agriculture and technology, to the atmospheric environment.

DO YOU KNOW A DYSLEXIAC?

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THE judge of the Juvenile Court looked at Bobby, twelve years old, and wondered what made him such a rascal. The youngster had been hauled into court for attacking his bedridden father and playing truant from school. Rebellious and defiant, he was headed for trouble. The judge learned from the court psychologist that Bobby was suffering from dyslexia, an inability to learn to read by the usual methods. This handicap was at the bottom of his delinquency.

What puzzled the judge even more was the psychologist's report that the boy had good general intelligence. He was self-reliant, able to care for himself, and could size up a practical problem in a mature way. Just recently, without any money, he had traveled thirteen miles on his first subway ride to the zoo and returned home in time for supper. Later on he explained that he wanted to see some of the strange animals he had heard about; that they were more interesting than his class work. The reasoning was solid enough, particularly when the judge learned that for six years Bobby had been a member of the same "ungraded" class because he could not learn to read like other children. Quite understandably, he resented being associated with children much younger than himself and having to take the taunts of some of his neighbors. Bobby learned at a tender age the stigma society places upon the person who cannot read.

Somewhat more dramatic than the run-of-the-mill cases, Bobby's problem serves to illustrate the serious consequences often growing out of dyslexia. We live in a civilization based on speech, reading, and writing—a linguistic civilization, if you please. And those of us handicapped in the use of these indispensable tools of civilized man have a hard time of it.

Bobby's experience also illustrates how the removal of a handicap can result in complete rehabilitation of the personality. For, once the boy's difficulty was identified and analyzed and he was given specialized training, he learned to read and to take his rightful, happy place among boys and girls of his own age.

How many people with dyslexia there are in and out of the schools no one knows, but the indications are that they exceed the total of the blind, the deaf, and the insane. From Pearl Harbor until V–J Day more than 1,000,000 draftees were rejected or specially classified because of dyslexia. Yet the vast majority of these men attended school through the sixth grade, and less than 7 percent had low-grade intelligence.

Reading surveys conducted in the schools here and there indicate that from 8 to 25 percent of all children have reading disabilities. On the whole, these children are not deficient in intelligence. Another arresting fact is that males usually outnumber females in reading disabilities, the ratio being approximately 4 to 1. In all linguistic functions the female sex is more gifted, for girls talk earlier than boys; they have fewer speech disorders, such as stuttering, where the ratio is about 7 to 1, and they have larger vocabularies.

Almost all reading disability cases in the schools are identified as *developmental dyslexia* because they have no back-

ground of serious illness or head injuries. These children ordinarily "see" all right, but they confuse similarly shaped letters like *o, e, c* or *b, h, n.* Or they substitute words like *old* and *cold, eat* and *meat.* Sometimes words are read as mirror images. Spelling ability is also affected, and eye strain is a frequent complaint among them. They often lack precision in recognizing complex patterns or fail to react to words as units but spell them out in a fumbling, trial-and-error sort of way.

As a group their immediate auditory memory span is short, and many of these children have speech defects. Stuttering, for example, is about eight times more prevalent among dyslexiacs; and articulatory disorders such as lisping and infantile speech, about twice as common. There seems to be some connection between certain speech defects and dyslexia. That is why psychologists favor delaying the teaching of reading until the youngster develops fluency of speech and listening discernment, even though not all children with mutilated speech are necessarily dyslexic.

The description and diagnosis of developmental dyslexia is guided by our knowledge of what constitutes efficient silent reading. The good reader finds no difficulty in following horizontal lines from left to right, and his eye movements are *saccadic,* that is, they advance by spurts rather than travel smoothly. But what is equally important, his regressive eye movements are few. He recognizes words in a group, known as the *span of recognition.* Pauses are short between spans. This is significant when we recall Tinker's findings that 94 percent of all reading time is ordinarily devoted to pausing, or *perception time.*

The good reader holds the thought and does not make a habit of returning to the beginning of a unit he has already read. In the technical jargon, he has few *return sweeps.* Neither does the good reader mouth his words as he reads, for mouthing puts the brakes on speed; nor does he have poor binocular coordination. He does not reverse nor transpose letters or syllables, a phenomenon known as *strephosymbolia.*

Strephosymbolia, which literally means twisted symbols, is marked by *static reversals,* exemplified by the consistent substitution of *p* for *b,* etc.; or words like *pot* and *tip* are read in their mirrored form as *top* and *pit;* and there are *erratic reversals* in which a letter like *l* may sometimes be read as *k* and at other times as *h.*

In short, the good silent reader is a rapid reader; he understands what he reads; and he remembers what he reads as he goes along.

As EACH case of dyslexia is highly individualistic—bound up with the total personality—he should be studied as carefully as possible and a re-educational program built around his specific needs. A checkup on physical health is indicated first. This should include a basal metabolism test. Many young dyslexiacs have under- or overfunctioning thyroid glands, for example. The former is often responsible for sluggish attention and dull intelligence, and the latter is sometimes associated with hyperactivity and emotionality, a syndrome colloquially identified by some psychologists as *antis pantis* or even *termitus trouserus.*

The case of a boy nine years old is pertinent. Underweight, he suffered from insomnia and wide swings in mood. Sitting still was difficult. These basic difficulties had to be resolved before a detailed diagnosis of his reading disability could be undertaken and a re-educational program prescribed.

Because many of the current methods of teaching reading are kinesthetic, the study of the dyslexiac's motor coordina-

tions is helpful. Many dyslexiacs are unusually clumsy and fail to carry out ordinary skills in the use of the hands and eyes. That is why they are called *apraxic*. For them, motor retraining may be the first step in their reading rehabilitation.

Identification of the dyslexiac's preferential hand and eye may also reveal helpful information. While the subject of handedness pivots on conflicting points of view, many authorities agree that (1) a child should not be forced to write with his right hand when he prefers the left; and (2) when ambidexterity in writing exists, the child should be trained to use one hand, preferably the one on the side of the dominant eye. Instruments like the microscope, kaleidoscope, and manoptoscope can be used to determine eye dominance. In privileged communities, ophthalmographs and ophthalmic telebinoculars are available for photographing and studying movements of the eye during reading.

Dyslexiacs also need periodic examination for visual acuity and coordination. Corrective lenses and prism exercises are sometimes prescribed by the oculist for strengthening certain muscles and coordinations. Although lowered vision is not the usual cause of developmental dyslexia, instances of aniseikonia, nystagmus, myopia, and strabismus are not rare. Tests for Daltonism, or color blindness, should be given because many re-educative exercises are based on association of colors with words. If the dyslexiac is color blind he will not profit from such exercises; indeed, they may add to his confusion. Dyslexiacs in the schools should be provided with excellent lighting and front seats.

Audiometric examinations are also necessary and should be administered at least once a year. Approximately 1.5 percent of the entire school population in our country are hypacusic. While this group may hear many noises and some speech sounds—thus unknowingly disguising their aural losses—their hearing is dull enough to interfere with their learning and human relations. As many re-educational drills for dyslexiacs are based on phonics and phonetics, it is important that they should hear all the speech sounds, of which the American language contains approximately forty. A significant hearing loss may call for a mechanical or electrical hearing aid or lip-reading instruction before the dyslexia is attacked.

This brings up the subject of good speech as an invaluable asset in learning to read. As the spoken word is more basic than the written word and its interpretation—that is, reading—speech defects should be attended to as early as possible. In enlightened communities good speech habits are stressed throughout the grades and high school and particularly in the kindergarten and first grade, *before* children are taught to read. A child pronouncing *three* as *free* or *row* as *wow* or *sister* as *thithter* has a potential reading handicap.

Is the child ready to read? Think of three boys, all six years of age, with similar backgrounds and intelligence. One finds reading easy and enjoyable; the second learns with great difficulty and hates it; and the third does not learn to read at all. Some psychologists believe that if the second and third boys were not taught to read until they were eight years of age, they would learn to read more efficiently. In other words, there is such a thing as *reading readiness* just as there is speech readiness and walking readiness. That is, we differ one from the other in the time of life when our physiology and psychology are ready to adapt to various functions. If our schools would wait until the second or third grade to begin to teach reading,

we would undoubtedly have fewer dyslexiacs.

Dyslexiacs ordinarily have emotional maladjustments growing out of their reading disability. Children are especially great conformers to the standards of their group. If it is customary for youngsters attending a certain school to cover their textbooks with brown paper and one boy's mother covers his with oilcloth, he may be laughed at. If the boys wear trousers, the newcomer who wears knee pants will be ridiculed. And so it is with a reading disability: the dyslexic child is made to feel "different" from his associates. Attitudes of inferiority and frustration become the building blocks for personality quirks that often persist long after the dyslexia has been corrected. A person who cannot believe what his eyes tell him lacks assurance every time he looks at the printed page.

Determining the dyslexiac's interests and hobbies ordinarily uncovers a good deal of matter on which to build reading interest. One boy of ten who had not yet learned to read was preoccupied with airplane models. The psychologist won his interest in reading with a copy of Jordanoff's illustrated *Aeronautical Dictionary*. Through the invention of word games involving airplane parts, meteorology, and allied subjects, the boy was soon taught to read. This kind of approach to the problem can be carried out at home too, with mother and father supplementing the psychologist's outline of procedure.

Once the reading disability is diagnosed, various methods are available for the re-educational program. By and large they are designed to strengthen visual learning by calling on the other senses as teachers. For example, before the child is given printed matter to study, he may get the "feel" of the alphabet by tracing six-inch letters on the blackboard; then on large pieces of tracing paper; finally, in hand-writing size. Lettering by hand is preferred to cursive writing because of its closer resemblance to printed characters. Sometimes he is asked to say the sound as he traces or prints the letter. Small children discover interests in words printed large on pictures. Word games are made of the picture cards. Some psychologists advocate mechanically controlled flash cards and the metronoscope for training eye movements and word recognition. Others find them creative of habits not always useful in learning to interpret the printed page. Here, too, the old adage holds: "What's one man's meat is another man's poison." Only by studying the individual dyslexiac and supplying him with those aids that satisfy his needs is an optimum of progress assured.

Printed materials should always be selected with due care to typography and pagination. We have found 24-point type, preferably in boldface, best for the majority of young children. We never use print smaller than 14 point for children under eleven years, at least in the beginning. Paper ought to be free of glare, margins should be wide, and indentions deep.

Some years ago The British Association for the Advancement of Science recommended a 100-millimeter line for children over eight years of age. Dearborne advocates a length of 85 millimeters, which is approximately 3.5 inches long. *Reader's Digest* columns are 2.25 inches wide, undoubtedly one of the reasons (unconscious) for its tremendous popularity. Spacing between letters should be at least .3 millimeter. Lighting, seating posture, and position of the reading matter are of basic importance also.

No CONSIDERATION, however, is more significant than strong *rapport* between

the dyslexiac and his psychologist or teacher. Rapport, which is a reciprocated feeling of respect, confidence, and even affection, is invariably at the bottom of sustained progress in reading rehabilitation just as it is in so many other human relations. Certainly rapport plays a stellar role these days in retraining the many new cases of *acquired dyslexia* growing out of the war.

Acquired dyslexia identifies those cases of reading disability that follow an injury to the brain. The person afflicted with acquired dyslexia ordinarily has learned to read and then, as the result of a brain lesion caused by head wound or brain tumor or arteriosclerosis, has lost the ability to read in whole or in part. Occasionally a symptom is *hemianopsia* in which one-half or a substantial part of the scanning vision is lost. Such an injury usually entails many other disturbances of the linguistic functions, as the following representative case history illustrates.

When asked questions such as "What is your name?," "Where do you live?," "How old are you?" this man, thirty-six years old, would answer with a neologism, "Senowin." After saying this he would point to his tongue, frown, and shake his head. The examiner interpreted all this to mean: "I'm in a bad way; I know what to say but can't say it." He was unable to say any words at all except two profanities and "One, two, three, four, five, six, eight, ten," invariably omitting "seven" and "nine" and never getting beyond "ten."

But when asked to carry out directions like "Close the door," "Raise your right hand," or "Point to your left foot," he would follow them quickly and correctly, thus indicating that he understood oral words. Moreover, he could write some simple words such as *Bob, street, in.* But polysyllabics like *Mississippi* or *gentleman* he would not even attempt, saying, "Senowin." On various occasions, when asked to write words like *saw, on, tab,* he wrote *was, no, bat.* Spelling gave him much difficulty also, whether written or recited.

Given a standardized reading achievement test of the third grade, he identified only an occasional word such as *dog* and *cat,* and these were sometimes read in mirrored images as *god* and *tac.* His dyslexia was characterized by (1) ignorance of almost all words and (2) reversal tendencies in reading the few that he could identify.

This case of acquired dyslexia and associated disorders is particularly interesting when reviewed against a background of widely held beliefs of the functions of the brain in relation to speech. The cerebrum, or large brain, which is divided into hemispheres, controls both the muscular activities and their coordination in speaking and reading as well as the capacity to understand the spoken and written word. Physiologists have known for a long time that the hemispheres govern opposite sides of the body. Many of them maintain that one hemisphere is ordinarily dominant—that is, it has a higher rate of metabolic action than its opposite—and that the dominant hemisphere is located on the side opposite the preferential hand. They also maintain that the centers controlling the various linguistic functions are in the dominant hemisphere. In the words of S. T. Orton, "One side of the brain is all-important in the language process and the other side either useless or unused." It is believed that through re-education those brains cells not destroyed or injured can take over the linguistic functions.

This theory is nicely illustrated by the case under discussion, for the man was reported to have had no speech or reading handicaps prior to the onset of a paralysis which occurred one day as he

was greasing his truck. Found groaning by a relative, he was taken to a hospital where he remained for six weeks. The paralysis, confined to the left side of the body, gradually disappeared so that by the time he left the hospital he had regained the use of the larger muscles, thus enabling him to walk and grasp. But from the onset of the paralysis until he began a re-educational reading and speech program he did not talk except for the words listed and the neologism. His relatives were in agreement that he had always been left handed. As he was paralyzed on the left side and was left handed, it was believed by the neurologist at the hospital that a thrombosis had struck the right hemisphere. If the thrombosis had affected the left hemisphere, the right side of the body would have been paralyzed without involving any dyslexia and related disorders of language, according to this theory. Through individualized training conducted daily over a period of thirty weeks, the man learned to speak and read well enough to return to his vocation of truck driver.

It is interesting to note that many head wounds did not, in the recent war, entail dyslexic symptoms, although according to available reports the large majority of veterans wounded on the side of the head opposite the preferential hand presented disorders of reading and speech, varying in extent from a passing confusion to total word blindness and mutism. Most authorities are in agreement that of all linguistic disorders those growing out of lesions on the big brain are as a group the most involved. Re-education in reading, writing, and speech in such cases requires sustained effort by experts working in close cooperation with neurologists. Even so, acquired dyslexia, like developmental dyslexia, is amenable to improvement or complete rehabilitation.

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SCIENCE AND THE PURSUIT OF VALUES

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IT HAS now become quite evident that at least one effect of the atomic bomb was not clearly foreseen by those who were responsible for its use. The physical effect—the destruction of life and property—this was predicted with a fair measure of precision. The political effect—the problem of secrecy, with the ensuing diplomatic issues—this was, perhaps, vaguely anticipated. But the widespread interest on the part of literary men, scientists, philosophers, politicians, and educators in the broader problems of the freedom of research, the role of science in liberal education, the relations between the natural and the social sciences, and the still more inclusive problem of the general nature of science as an enterprise of the human spirit—this, I should suppose, could not have been anticipated by any of the experts who had advance knowledge of the world-shaking event.

The fact of such interest can, I think, hardly be doubted. Evidence abounds in the pulpit, in current periodicals and newspapers, and on the lecture platforms. Scientists, who have heretofore cautiously refrained from dabbling in such "extrascientific" problems, are venturing to address forums, literary guilds, and luncheon clubs on precisely these issues. Educators, either fearing that the demonstrated importance of science will result in a crowding of cultural subjects from the curriculum or welcoming the renewed emphasis on science as an opportunity to gain much needed governmental aid in support of local research, are examining graduation requirements and the aims of education with reference to the proper role of science in the training of the citizen. Politicians, knowing little of the method and spirit of science, are deliberating over possible restrictions on the freedom of research and of the dissemination of scientific information and may soon, if history is to be relied upon, initiate discussion as to the advisability of introducing a tax on atomic bombs as an unexpected and fruitful source of government revenue. Philosophers, always on the alert for the basic issues involved in any enterprise, are becoming increasingly distressed by the narrowness of the traditional scientific outlook and the unwillingness of the scientist to see his discipline in its broader social context.

The effect of this widespread discussion of the general nature of science on our understanding of science itself cannot yet be ascertained. There is too much diversity of outlook in the various approaches and too much conflict of opinion in the solutions offered. But it seems reasonable to conclude that the effort cannot be wholly wasted; in the long run science stands to profit by a renewed interest in its nature and role in contemporary civilization. While the general impression one draws from such discussion is essentially confused, since the terminology in which the debate is carried on is vague and ambiguous and the problems themselves are not too well understood, some progress is being made. Though the issues are not being met, they are being isolated and clarified. New relations are emerging as significant—science *and* politics, science *and* education, science *and* value, science *and* society—relations which are at least bringing into juxtaposition aspects or phases of our culture which we have been content, by a vicious abstraction, to

consider in complete isolation. More than this, attention is now being drawn to the fact that science is not merely the special sciences—physics, chemistry, biology—but a unified outlook and method common to all the special disciplines, a unique way of viewing the world and man, a significant enterprise of the human spirit. We are thus beginning to find ourselves, more than at any time in the past, in a position to gain a new perspective on science, to see it as something more than test tubes and ammeters, more even than scientific periodicals and treatises; to see it, in fact, as one of the most inclusive and characteristically human modes of reacting to the world about us.

Much of the current discussion is vitiated by a point of view which, although favored by tradition, is unfortunate for the adequate understanding of science. Science and value, it is claimed, are utterly incommensurable. Any interest which is scientific can have nothing to do with values, and any concern with values must lie outside the realm of science. Look, for example, at the scientist. He is the ideal exemplification of objectivity and unemotionality. Preferences and aversions, hopes and fears, likes and dislikes—which are the habitat of values—are foreign to him; he is coldly logical, justly disdainful of emotional claims, and continues doggedly at his task until observation is brought into agreement with prediction. The pursuit of values may be an important activity of the human spirit, but the pursuit of values is not science and is therefore not for the scientist. Values are private, personal, and subjective; truth is public, impersonal, and objective. Nothing is good or bad but thinking makes it so; beauty depends on taste; even God is required only when our feelings, and not our intellectual needs, demand satisfaction. Science will have none of this. Its seed is fact; its nourishment is careful observation and cautious reasoning; its flower is abstract truth, pure and undefiled.

The result of this outlook is a misunderstanding both of science and of those value pursuits to which it is opposed. Science, so conceived, becomes a value activity only in terms of context, only when placed in the social situation and examined with reference to the uses to which its results can be put in the problem of social control and social betterment. *Practical* science has to do with values; *pure* science does not. Practical science is, like art, religion, and morality, one of the "humanities"; pure science is not.

I shall attempt to show in what follows that science—pure science—is not fundamentally different from art, religion, and morality. It is, like these other activities, a characteristic mode of human behavior in which man sets up for himself a certain goal which he considers highly desirable and which he endeavors to achieve by appropriately selected techniques. In order to demonstrate this I shall try to show, first, what essentially is involved when one speaks of art, religion, and morality as value activities or value pursuits; second, what features exhibited by science afford ground for assigning to it a basic kinship with these other value disciplines; and, third, what consequences for our understanding of science ensue if we place it in this perspective.

IF, FOLLOWING Aristotle, we define man as a "rational animal," we run the risk of two serious errors. In the first place, man is not *merely* rational; he is religious, moral, aesthetic, and social as well. By emphasizing his rational capacities, therefore, we overlook entirely, or relegate to a secondary position, these other phases of his life which, for many, are dominant both in terms of the significance which they give to life and in terms of the actual portion of man's ex-

perience, quantitatively speaking, which he devotes to them. In the second place, to characterize man as essentially rational is to disregard the fact that men draw upon their rational faculties, except in rare cases, only for the purpose of achieving certain goals which are, if not irrational, at least nonrational. The desire to live well cannot be justified on rational grounds, nor can the desire even to live at all. It is in the realization of these ultrarational preferences that man needs the rational faculties as instruments.

It seems more accurate, therefore, to define man as a "valuational animal." By this is meant simply that he is a creature with likes and preferences on the one hand and dislikes and aversions on the other, who sets about by appropriately directed activities to maximize and render permanent the positive values and to eliminate, minimize, or render transitory the negative values. Many of these preferences and aversions are specific and temporary—as in the case of liking or disliking certain foods, certain modes of dress, certain types of amusement, certain types of people. But all such valuational attitudes can be grouped, in terms of the objects desired, into general classes which may be called the characteristically human and enduring appraisements. Among these basic objects of desire will be found health, recreational values, wealth, pleasure, love, goodness of character, piety or spirituality, and beauty. Around each of these values there gathers a cluster of activities and experiences which are united to one another by the common end. Morality, for example, is the sum total of activities performed by the individual and the sum total of experiences through which he passes in his attempt to achieve an ideal or standard of "right living." Art, similarly, is a name for those phases of human behavior and enjoyment which are concerned with the realization, either in the form of creation or in the form of appreciation, of the value of beauty. Religion—somewhat less adequately defined because of its complexity and because of the manifold forms under which it has appeared—is that aggregate of experiences, including prayer, worship, and meditation, which are directed to the realization of an attitude of spirituality or piety, which is a way of looking at the world designed to comfort man in times of sorrow, afford him something before which he may humble himself, and inspire him by virtue of its fundamental position in the universe to continue his struggle against the forces of evil.

Is there anything common to these various forms of value pursuit? It seems evident that however the values may differ there is the recognition in each case that the value in question is in some sense ultimately and finally desirable and worthy of attainment, even though such attainment involve the sacrificing of other values. To ask why one pursues the value is to ask an unanswerable question. The only reply—which is really not a reply at all—is to say that man is so constituted that he *does* esteem this particular thing highly and is willing to forsake some of the other treasures of life in order to get it within his grasp. Once the values have been selected, their achievement then becomes the directing factor in the life of the individual; henceforth he selects his activities, rationally or irrationally, with a view to their presumed efficacy in enabling him to realize the final values. In terms of these goals the activities and experiences prove satisfying or dissatisfying. Disappointment, despair, and frustration occur when progress toward the goal is too slow or when attainment of the value in question involves abandoning other values which are themselves desirable. Satisfaction, enjoyment, and a sense of well-being occur

when the choice of means proves to have been successful and when the individual is able to recognize that the goal, once remote, is now almost within his grasp.

We may conclude, then, that to be human means to pursue values. As a result of the diversity in our organisms and environments, the things which are valued are many and various. But they tend to fall into certain well-defined classes, which represent basic types of value preference. However diverse and specific may be the objects of men's desires, the things which they prefer ultimately and for which the more specific values are instruments or means prove to be surprisingly alike. These final values, then, may be taken as principles according to which we may break up his total experience into clusters of activities and enjoyments. Among such unified aggregates of experience we find art, religion, and morality.

Is SCIENCE essentially like art, religion, and morality, or does it differ fundamentally from these modes of value pursuit? Evidently the issue cannot be settled with any finality. Since any two things which are alike are also different in some respects, no complete identification of two things is ever possible. But by emphasizing similarities we may, and often do, gain an understanding which would have been impossible if we had attended merely to the differences. The question, then, is whether by considering science as a value pursuit we are not enabled to gain new insights into its nature, to understand it, that is, both in its essential character and in its relations to the broader context of experience in which it inevitably occurs.

At first glance the resemblance seems very striking. Science *is* the pursuit of a value—a value which is clear-cut and demanding. Whatever else science may be, it is an unusually persistent effort to achieve truth, wisdom, understanding, or knowledge. (For the purpose of this discussion these terms may be identified.) No one, I should suppose, would question the fact that the scientist desires these values in some significant sense above all other things. Whether they are in and of themselves desirable, or merely desired as instruments by which humanity may be bettered or life may be made more comfortable, is not relevant to the present issue. Evidently any one of the values of life may be desired as a means to the attainment of other values. But there must be at least one value which is preferred in and for itself. For the pure or theoretical scientist knowledge is an ultimate and final value; for the practical scientist or engineer knowledge has value as a tool which may then be employed to realize another value—say, better living—which then itself becomes an ultimate or final value. If we grant this it becomes clear that science is a broad and inclusive term covering all the activities—observing, experimenting, measuring, generalizing, forming hypotheses—and all the psychological experiences—excitement, interest, enthusiasm, as well as despair, discouragement, and frustration—through which the scientist as a human being passes in his attempt to realize the goal of adequate knowledge. We are so accustomed to thinking of science in terms of its results that we tend to overlook the fact that science is, properly speaking, *scientists*. Scientists are human beings like you and me who, unfortunately, suffer from dyspepsia, hate to pay their income taxes, and have family troubles but who, fortunately, enjoy the company of friends, take pleasure in a cigar, and like to go fishing. What is more important, the pleasures and displeasures which they experience in their scientific activities are of essentially the same kind as those which they enjoy and suffer as common men in the practical relations of life and society. Science is,

then, like art, religion, and morality, a complex of behavior adjustments and emotional reactions which derive their unity from the fact that they are selected, employed, and appraised by the individual in terms of their efficacy in enabling him to achieve a state in which he can be said to have satisfactory knowledge of the world about him.

Even more striking resemblances between science and the other forms of value activity appear as one penetrates beneath the surface. Characteristic among these is the feeling of "oughtness" which seems always to be present in the pursuit of any one of the major values. This feeling appears whenever the conflict between the *desired* and the *desirable* becomes dominant. To say that value is *desired* is, in a sense, to utter a truism; for if a thing is not desired then it is simply not a value for the individual concerned. But to say that a value is *desirable* is not to assert a mere platitude; for if a thing is *desirable* then it *ought to be desired*, and the plain fact of the matter is that we do not desire many things which we feel that we ought to desire. To decide between what we want and what we feel we ought to have—this represents one of the most pervasive and unsettling conflicts with which man is confronted. In the moral sphere the opposition is between pleasure and duty; in the sphere of art it is between what we personally and privately like and what the critic tells us we should enjoy; in the sphere of religion it is between the many temptations which life offers and our responsibilities to God.

Science, too, exhibits this conflict. In fact, the very presence of decisions of this kind in science has led many to believe that the scientist is not concerned with value. But the truth is that such a choice is a choice *between* values *within* science. The feeling of obligation is strong in science, and that which ought to be preferred usually wins over that which is preferred. It is this strong responsibility to an ideal that restrains a scientist from publishing before he is sure of his results but also impels him to publish them as soon as they have been checked; this same feeling tells him that the unfettered imagination, however inviting its products may be, has no place in science; that observations obtained under conditions of haste, excitement, or fatigue, however urgently they may have been needed at the moment, are thoroughly unreliable; that "pet" theories must be verified with extreme caution because of the emotional halo which surrounds them. None of these is a case of throwing value out of science; rather, certain values—those of objectivity in attitude and caution in method—are held to be dominant over those of emotionality, personal prejudice, haste, and carelessness. The scientist is not a logical machine; he is only a machine which automatically employs approved rather than disapproved techniques of thinking.

A third characteristic of value pursuits is the presence of qualitative distinctions between values—distinctions between higher and lower values. The classical illustration of this is to be found in the writings of John Stuart Mill, who, arguing against the earlier utilitarians and their insistence on the primacy of the principle of quantity as a basis for deciding between the desirability of competing pleasures, pointed out that on these grounds "pushpin would be as good as poetry." Since poetry, according to Mill, is obviously to be preferred to any simple game, the necessity arises for making a qualitative distinction between pleasures; poetry may not produce more pleasure than pushpin, but it produces a "better" pleasure. Whatever one may think of Mill's illustration and even though one may argue convincingly that pushpin *may* produce a higher quality pleasure

than does poetry, nevertheless qualitative distinctions between values *do* appear in all the value pursuits. In science the problem is illustrated by the difference between particular truths—"The mass of this piece of iron is 17.2 grams" or "This is an example of *Canis familiaris*"—and general truths or theories—Boyle's law or the evolutionary theory. Both types are truths and therefore fit into the general picture of science; but the latter seems to be on a higher level, to be more significantly involved in the forward movement of science. Thus there arises, at least in the minds of some, a distinction between the aristocrats of science who concern themselves with the "higher" truths—laws, basic presuppositions, integrating theories, and wide generalizations—and the plebeians in science who, at least in the eyes of the aristocrats, are mere fact-gatherers, gadgeteers, and pebble pickers. Whether the aristocrats and plebeians are properly identified here is not pertinent to the discussion. One might argue that since all theory must rest upon fact and there are clearly times when one fact is worth a hundred theories, those who are concerned with particular facts are the real aristocrats of science and the theoreticians are scientific philanderers and wastrels. The point is not whether particular facts are high-quality truths or low-quality, but whether the distinction applies at all to scientific truths. General truths are not more true than specific truths, nor is the reverse the case; both are truths, just as pushpin and poetry are pleasures, yet one seems preferable to the other on grounds of quality. That science does exhibit this distinction strengthens the reasons for a closer identification of science with the other value pursuits.

It appears, however, that there is one important difference between science and the other forms of value pursuit. Art, religion, and morality all seem to demand sooner or later in their development something which can be called *justification.* Art which begins as an immediate and unanalytic enjoyment ultimately cries out for an intellectual analysis of idea, form, and pattern; morality which originates as an automatic yielding to the dictates of conscience and training asks for principles of behavior and demands proof of the freedom of the will; religion which is born in a spontaneous outpouring of the soul finally seeks creeds and theologies. The demand for justification, therefore, is a demand for intellectualization. This seeking for reasons is, in the broad sense of the word, science itself. What this means is that the nonintellectual pursuits demand and receive justification in terms of the intellectual pursuits—morality in terms of ethics, art in terms of aesthetics, and religion in terms of the science or philosophy of religion. Thus science proves to be not itself a value pursuit but that unique feature of experience which is itself the justification of all value pursuits.

The truth which is involved in this claim unfortunately hides the error which is also contained in it. Science can, in a very significant sense, be said to be the justification of the nonscientific value pursuits. But this does not mean that science itself requires no justification. On the contrary, science demands justification on the same grounds and for the same reason that art, religion, and morality do. Is it not true that the scientist at an earlier or later point in the course of his work begins to be uneasy about the assumptions of his procedure—about the rationality, objectivity, and uniformity of nature, about the validity of the laws of logic, about the adequacy of communication? However unwelcome these guests may be in the house of science, they cannot be summarily dismissed. Whether he tags them "postulates" and allows them to remain,

whether he tolerates them on the pragmatic grounds that without them he would be unable to produce results, or whether he accepts their invitation to leave the scientific citadel and make an excursion into the realm of philosophy—in any case he recognizes that without an examination of these presuppositions science must remain unjustified. The analogy, therefore, between science and the other value pursuits seems remarkably close. So long as neither the individual or society has reached maturity an uncritical aesthetic experience, a cut-and-dried system of moral principles, a naive religion, and an unreflective science are entirely adequate. But when the individual reaches the age of discretion and when society attains a certain intellectual growth, dissatisfaction arises in all these activities. The experiences in their simple forms are no longer adequate to the increasingly complex situations to which the individual and society must make adjustments. Re-examination and criticism, rational justification, are called for, and the experiences undergo modification and extension. It is then that science begins to play its peculiar double role. The nonintellectual value pursuits require science for their justification; but science itself, being a value pursuit, requires for its justification that superscience which is commonly called philosophy. If we emphasize the one role of science—that in which it constitutes the justification of the other value pursuits—science seems fundamentally different from these other activities; but if we emphasize its other role—that of something which itself requires justification—we see its fundamental kinship to the nonintellectual experiences.

Enough has been said, perhaps, to indicate that science, interpreted as the pursuit of truth or knowledge, is in many significant ways strikingly like the other characteristic modes of value enjoyment. It remains to be shown how such a perspective on science enables us to see this discipline more clearly in the broader context of experience.

Similarity does not, of course, mean identity; whatever may be the results of our previous discussion, therefore, we should not think of science as without significant features of its own or as substitutable for the other value experiences. The unique character of any value activity lies in the value which is pursued. Since truth is not piety and goodness is not beauty, science cannot be religion nor morality be art. But this does not mean that the various modes of experience are unrelated. A man may be a better (or worse) scientist because of his piety, and he may be more (or less) pious because of his science; similarly, one's enjoyment of moral values may affect the pleasure which he derives from artistic values, and conversely. It must be remembered that man's experiences constitute an organic whole which should not itself be torn apart by the act of intellectual abstraction in terms of which we try to understand it. What is to be emphasized is that each of the value pursuits, uniquely characterized by the goal it seeks, nevertheless exhibits elaborate and complicated relationships to all the other values and corresponding experiences. Man achieves a satisfying life largely to the extent to which he is able to include the widest range of such experiences with the minimum of conflict between any two. Life is less adequate to the extent to which it is narrow, as in the case of the uneducated expert, the religious fanatic, or the aesthete who is idiosyncratic and socially maladjusted. Similarly, life is dissatisfying to the extent to which it is lacking in integration, however wide its sweep may be.

One of the most disturbing value conflicts, in the minds of many people, is

that which is commonly found between science and religion. The range and variety of solutions which have been offered to this important problem are a tribute to the intellectual genius of mankind. Most of these solutions, however, fall wide of the mark because they are based upon a fundamental misconception either of the nature of religion or of the nature of science. In view of the preceding discussion the points to be kept in mind seem comparatively simple. Science and religion are value pursuits of essentially the same kind. Their differences, so far as they exist, are to be found in the natures of the values which are pursued. The value experiences are satisfying to the degree to which the proper values are realized. But the values themselves, unfortunately, sometimes conflict. This hostility, or incompatibility, of values occurs over the total range of preferential judgments, from such simple situations as the impossibility of having our cake and eating it to the more sweeping and more profound conflicts of a Socrates who must decide between an honorable death and a dishonorable life. An individual is able to meet a situation of this kind adequately to the extent to which he has already built up for himself a satisfactory philosophy of life. Such a philosophy, based upon an inspection and analysis of the many possible values which life has to offer, expresses the individual's complete value perspective or value outlook. It usually takes the form of a value scale in which the many "bests" of life are so arranged as to indicate clearly which is *the* best and therefore never to be sacrificed for any of the others. The conflict between science and religion can be resolved in the only way in which such a situation can ever be adequately met, that is, with a minimum of sacrifice and accompanied by a recognition that the sacrifice is rationally grounded, if the individual is provided in advance with a value scale on which truth and piety have been properly located. If the religious value is deemed to be supreme in life and truth is given a secondary place, a conflict between truth and piety will require the individual, in all consistency, to sacrifice truth and believe on faith—accepting the small boy's definition of faith as "believing what you know ain't so." If the intellectual value is on top, the converse decision must be made, and the achievement of truth may, on occasions, involve acts of impiety. All this is, of course, an extreme oversimplification of the problem. It neglects entirely the fact that at times a higher value may be temporarily sacrificed to a lower one, that there may be a convergent value to which both truth and piety contribute, and that one's value perspective is itself a reflection of his experience, hence subject to change through intellectual growth and advancing years. But the principles for the resolution of the conflict seem clear. And they apply equally well in the case of an opposition between art and morality, art and science, religion and morality, or any other pair of value pursuits. What must be kept in mind is, first, that apart from a philosophy of life all the value pursuits, including science, are on the same level, and, second, that on the basis of such a philosophy alone can rational judgment be made.

Reference may be made, in conclusion, to the educational implications of this view of science. At one stroke the opposition between science and the humanities is eliminated, for science *becomes* one of the humanities. It is a significant enterprise of the human spirit with an exciting past and an enticing future, meaningless apart from human personalities, social groups, and cultural epochs. It therefore has its own history, psychology, sociology, economics, politics, geography, and philosophy. To argue that all these are not properly part of

science is to deny that they influence, and are in turn influenced by, science. In a broad sense where significant relations of interdependence exist, there the part-whole relation exists. To abstract science from this broader context is to reject factors that are essential to the proper understanding of the term.

May it not be presumed that the teaching of science, modified in the direction of less emphasis on specific factual material and more emphasis on methods, general principles, and cultural context, would be readily granted an important position in any college curriculum designed to produce a liberally educated man? No humanist, however antiscientific his prejudices might be, could possibly justify excluding it from such a program. Not only would science be required for a *general* education, it would be necessary even for a *humanistic* education; for the omission of science would be equivalent to the neglect of an important human undertaking. The student would not adequately know the humanities if he did not know science. That the traditional course in science would not meet this demand seems clear. Perhaps—though this might be argued—we need two courses in science, one for the future specialist, taught along customary lines, and the other for the student who is concerned with laying the broad foundations of a general education. All sorts of awkward problems involving matters of curriculum, administration, and even vested interests and human personalities would have to be met in the implementation of this broader view of science in the academic program. But it is helpful, I think, to have this alternative outlook before us—to see science, in other words, in that more inclusive social and cultural perspective in terms of which alone future problems—whether they be of atomic bombs, of the freedom of research, or of adequate living—can be solved.

NO SINGLE THING ABIDES*

No single thing abides; but all things flow.
Fragment to fragment clings—the things thus grow
Until we know and name them. By degrees
They melt, and are no more the things we know.

Globed from the atoms falling slow or swift
I see the suns, I see the systems lift
Their forms; and even the systems and the suns
Shall go back slowly to the eternal drift.

Oh Science, lift aloud thy voice that stills
The pulse of fear, and through the conscience thrills—
Thrills through the conscience the news of peace—
How beautiful thy feet are on the hills!

* This is a translation by W. H. Mallock of the first, second, and last (twenty-second) stanzas of the poem by the Roman poet Lucretius (Titus Lucretius Carus, 96–55 B.C.). It was provided by Karl P. Schmidt, Chicago Museum of Natural History, who regarded it as "singularly appropriate" for the SM.—Ed.

LIVING WATER*

By John G. Sinclair

Salty water flowing deep as life
From aged sea to ageless reborn cell,
The basic mead of man or protozoan gel,
Nor greatly altered in the potent strife
That molds all form unto adaptive ends
By which evolved it swims or runs or flies.
Most constant milieu which forever ties
Us to our past, where'er that past extends.

The sea, prophetic, brews a chemic charm
Of magic dielectric and ionic pawn,
Of balanced valence in a solvent strong,
And catalytic trace where more would harm.
Conservator of clime where syntheses survive:
Actinic polymers to hold the brief sunshine,
Ammonia with carbon chains combine.
Aminic pool in which the proteins thrive.

Strange oneness with the globe upon whose face
Life spreads a transient film, its narrow zone
Unique perhaps upon the earth alone.
In tenuous uncertainty it builds the race.
The balance on whose outcome life relies
Requires that each with constant skill enacts
The homeostatic juggler in unnumbered acts
And reproduce its likeness e'er it dies.

What maintains balance in this saline flood?
What trigger substitute for driving pain
Leads restless ones to salt and water gain
With stealth more certain than diviner's rod?
What ways devised to lose or reabsorb
Regardless how osmotic gradient lies?
"By vacuole and nephron," life replies,
"By rodded cell and capillary orb."

Salty water flowing the full span
From aged seas to cellular retorts,
Cyclotic streams to cytoplasmic ports
Or crimson bath to warm the heart of man.

* This poem was written in tribute to Dr. Robert R. Bensley and his family of helpers who have devoted many years to the study of the structure of living matter and the maintenance of its equilibria.

SCIENCE ON THE MARCH

WHOSE SKULL IS IT?

FROM time to time police authorities send me human bones that have been exhumed and turned over to them under various circumstances. It then becomes my job to tell them as much about the bones as I can, usually centering around three main themes: age at time of death, sex, and stock, or race. Incidental to these items I may offer some idea of stature and general body build. Obviously, much of this is predicated upon the receipt of a more or less complete skeleton.

Upon occasion I receive only a skull, with or without the lower jaw. It is frequently an Indian skull, unearthed in the preparation of a Victory Garden, or in digging a sewer main, or in excavating for a foundation. Once in a while an ancient, unmarked "old settlers' " cemetery is invaded by the march of civilization. More rarely, a skull is found which shows evidence of violent death—a bullet hole, or a depressed or radial fracture. In this instance the obvious occurrence of foul play raises the problem of the identity of the victim.

The restoration of the living head from the skull (so-called craniocephalic reconstruction) is not new. The technique has been employed in archeological investigations on many occasions. There are two main methods: a drawing is made of the skull, and cephalic details are superimposed—hair, eyes, nose, mouth, ears; or the skull itself is used as the basis for restorative sculptural modeling, that is, details of physiognomy are modeled over the skull, which serves as a core, or nucleus. The second technique is by far the more graphic, for it gives a three-dimensional restoration.

All restorations attempted up to now have been based on unknown skulls; it has been impossible to check the restoration against a known head. Thus, the head of Paleolithic or Neolithic Man has been restored from skulls found in caves. Obviously, it was impossible to do more than estimate how the owners of those skulls looked in life; hence it was impossible to check the accuracy and reliability of the restoration.

I decided to do something about this situation. Accordingly, I selected a male American Negro cadaver, aged forty-seven years, from the dissecting tables of the Department of Anatomy of The University of Chicago. In the entire experiment I went from head to skull to restoration and then back to the head as a check—a "triple play," as it were. As far as I know, this is the *first test restoration* that has been attempted and reported.

The problem was, of course, to provide a modeled head that would be a very reasonable facsimile of the individual during life. Obviously, a cadaver head has certain limitations as a real control. With death has come loss of tonicity, of the tissue resiliency that imparts life to physiognomic detail. Be that as it may, I measured the cadaver head and face in elaborate and precise anthropometric detail, paying especial attention to those mid-line features that impart racial individuality.

Dissection then proceeded on schedule. Finally, I macerated the head to obtain a cleaned skull, complete with lower jaw, and turned it over to my associate in the experiment, Miss Mary Jane McCue, a sculptress.

During the course of the dissection note was made of tissue thickness at various areas of the head and face. These data were retained by me for the final

checkup. I did turn over to Miss McCue the following information: (1) my analysis of the age, sex, and race of the skull, determined in the same manner as though the skull were that of an "unknown"; (2) a table of average tissue thickness on the heads of twenty male Melanesians (Oceanic Negroes), gathered from the literature; (3) a table of average cephalofacial sizes and proportions in American Negro males, reported by Todd and his associates. This type of information is useful as a general guide to the sculptress.

Up to this point I had three sets of measurements, none as yet made available for comparison with the restoration: (1) anthropometric measurement on the cadaver head; (2) tissue measurements on the cadaver head; and (3) anthropometric measurements on the skull.

The sculptress then went to work on her own, save for the data given her by me. My instructions were: "I want the restoration to have the resiliency of life and the individuality of a middle-aged male Negro physiognomy." In pursuance of this goal the sculptress, in the finishing phases of her restoration, persuaded a Negro janitor of comparable age to pose for details of ears and lips (structures not indicated by the subjacent craniofacial parts). The head was then made available to me for comparison. It was measured and photographed (front, left three-quarters, left lateral) and compared with similar measurements and photographs of the cadaver head.

The measurements agreed astoundingly. With but one exception (bipalpebral breadth) all measurements, especially those of the important mid-line, agreed to within $\pm$ 1 mm. Most important of all, the restoration was recognizable as that of the subject chosen, allowing for the slack-jawedness of death and the firm-lipped reconstruction of living tonicity. We felt that the experiment—the *first rigidly controlled* craniocephalic restoration—was a success. The techniques employed may with confidence be added to the repertoire of medicolegal knowledge.[1]

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[1] For the details of this experiment see FBI *Law Enforcement Bulletin*, 15 (7), July 1946.

BOOK REVIEWS

THE VAGRANT MIND OF MAN

Adventures of the Mind. Arturo Castiglioni. Translated from the Italian by V. Gianturco. xviii + 428 pp. $4.50. Alfred A. Knopf, New York. 1946.

THE author of this interesting and scholarly book is a distinguished historian of medicine. Formerly a professor at the University of Padua, he was forced to leave his native land in 1938 when the Nuremburg racial laws were extended to include the Italian boot. Thus it was that Dr. Arturo Castiglioni came to America where he now teaches at the Yale School of Medicine.

Those readers who are already acquainted with the brilliant writing and erudition displayed by the author in his well-known *History of Medicine* may be assured that these qualities are not lacking in his latest book. Part of this volume was originally published some ten years ago in Milan. In its new and completed version, the translator, Mrs. Gianturco, has not merely translated the text, she has also preserved the lucid and scintillating style of the author.

Adventures of the Mind is essentially a study of the collective mind of man as it manifests itself throughout history. The thesis which the author attempts to expound is divided into three parts, each subdivided into nine chapters.

In part one, The Magic World, we find a fascinating discussion of magic among primitive men. This includes accounts of the functions of the magician, seer, and medicine man, of their personalities and powers, of their tools such as amulets, talismans, and fetishes, their practices, formulas, rites, and symbols, and even their secret societies. In part two we learn of Chinese magic of numbers and letters, the magic systems of the American Indians, the fantastic magic of the Hindus, the state magic of Egypt, Assyro-Babylonian speculative magic, Hebrew magic and the dawn of monotheism, magic and the mysteries of ancient Greece, and, finally, trends of official magic in ancient Italy.

Interesting as these earlier sections of the book are, the third part on the Decadence and Revival of Magic is, to this reviewer at least, the finest portion of the study. In masterly fashion Castiglioni gives us a compact outline of magic, witchcraft, and those strange manifestations of mass behavior which are called psychic epidemics and which seemed to be a peculiar characteristic of the Middle Ages. As examples of these psychic contagions which seemed to come as an aftermath of terrible disasters such as the Black Death may be mentioned the Flagellants, the so-called dance of St. Vitus, and the Children's Crusade of Schwäbisch Hill. By a strange coincidence, as this review is being written, there lies on my desk a copy of a daily newspaper dated July 6, 1946, with a story of mass suggestion and hysteria in which a nine-year-old boy in Poland repeated a medieval tale of witchcraft and ritual murder, thereby touching off a pogrom in which some forty people lost their lives. We see thus the ready parallels between the witch-hunts of the thirteenth to the sixteenth centuries and those of the twentieth. The hunting of witches, whether ecclesiastical or political, appears to be one of the chronic diseases of human society.

Finally, in attempting to find a solution to these collective diseases of the human mind the author examines such modern phenomena as the influence of Rasputin, Gandhi, Japanese secret societies, communism, nazism, and fascism. He attempts to characterize these mass

movements as examples of psychic contagion similar in their epidemiology to diseases of microbial origin. This is a most interesting analogy, but it does not seem to be a convincing simplification of a very complex phenomenon. Nevertheless, we must be grateful to the learned Dr. Castiglioni for a very instructive book.

MORRIS C. LEIKIND
LIBRARY OF CONGRESS
WASHINGTON, D. C.

THE WORLD OF SOUND

Die Welt des Schalles. Ferdinand Scheminsky. 2nd Ed. 820 pp. 189 illus. Verlag "Das Bergland-Buch," Salzburg. 1943.

A FASCINATING book! Its scope is vast, covering almost every phenomenon, every aspect, of sound. Sound production, perception, and related problems are presented in plain, modest, scientific language from which the traditional arrogance and painstaking "cloudiness" of German writers is wholly absent.

Ample credit is given to the work of American acousticians: for instance, Fletcher, in the field of overtones and sound perception; Sivian, Dunn, and White, on sound volume (dynamics); Edison and Berliner, for the discovery and development of the phonograph; Schmitt, Johnson, and Olson, on the chemical effects of sound.

While the book is semiscientific, it is very attractive, and even indispensable, to the musician since it gives the answers to many problems which puzzle the conscientious artist and shows him the way to their solution in practice. Of special interest in this respect are the chapters on tone volume, tone color, intensity and tonal qualities of the piano, the violin, and many other instruments.

Topics are grouped under five main headings with each part divided into several sections. The first part deals with sound and sound perception. It covers vibrations, their measurement, and the limits of perception by the human ear. An account is given of the effects of supersonic sound, for example on photographic emulsions, and of its lethal action on microscopic plant and animal cells—animals as large as fish have been killed by supersonic sound.

A discussion of how sound travels and its intensity and velocity under varying conditions is included, followed by a survey of observation, notation, recording, and various methods of artificial augmentation of sound waves. The relations between sound waves and their perception by the ear is analyzed, and this phenomenon is subdivided into tone color, pitch, and degree of intensity. Color is determined by partial or overtones which are present even in nonmusical noises. Pitch depends on the frequency of vibrations and on the amplitude of waves.

A more detailed picture of tone color follows, analyzing the influence of individual overtones upon the quality of the fundamental tone, making it mellow, soft, dark, bright, piercing, or thin.

Another section of great interest to the professional musician deals with pitch, color, and volume of sound as produced by standard musical instruments. It is demonstrated that the pitch of a tone is determined only by the first partial tone. The author points out the fact that the human ear reacts rather inconsistently to tones of equal volume but of different pitch, and its perception of pitch differences is limited. The development of scales among different civilized races is given, with interesting comments on the tempered scale, bitonality, polytonality, and atonality. The notation of musical tones is briefly sketched.

Physical loudness of tones is described as well as devices for amplification such as megaphones, funnels, and horns. Special mention is made of Beethoven's ear trumpets and the fantastic "Ear of Dionysius" in Sicily. The latter con-

sists of intricately shaped curvatures in the rock quarries of Latomia del Paradiso.

Various methods and apparatus for measuring sound volume are discussed, together with the reactions and limitations of the human ear in regard to volume. An amusing illustration is a passage from Schoenberg's *Gurrelieder* performed by 365 singers and players which, by actual scientific measurements, produced a fortissimo eighteen times louder than the roaring of a lion in the Berlin Zoo.

An analysis is made of sympathetic vibration and resonance and their demonstration through resonators. The resonance properties of the human body and those of monkeys and fish are examined. The necessity of resonance boxes is proved, particularly for stringed instruments, since strings are poor sound carriers. Chladni's tone patterns are mentioned.

A section is devoted to collision of sounds (combined tones). Here interference, cancellation of sounds, fluctuation (*vox caelestis* of the organ), artificial harmonic (Tartini), consonance, and dissonance are listed and demonstrated.

Sound in the open is compared with sound in enclosed spaces. This gives rise to a discussion of acoustics in halls and their often startling antics. As an example of measurement of distance and direction through sound waves, the author cites the fact that by projecting sound waves, ships at sea can ascertain the size of an iceberg at night and by calculating its volume avoid the obstacle.

The section concluding the first part of the book traces the development and usefulness of the phonograph for musical and medical purposes.

The second part of the book deals with sound production, beginning with a discussion of the patterns of sound waves of many types of sound-producing media, and continuing with the methods of tone production of many instruments, of speaking, singing, whistling, and of animal cries.

A third part deals with the functions of the organ of hearing in man and animals; another gives a picture of the role played by electricity in producing, conveying, and amplifying sound, with radio technique receiving due attention.

The last section is a collection of miscellaneous phenomena as a supplement, or appendix, containing descriptions of measurements of echoes useful for air pilots in determining altitude in foggy weather; flames as sound senders and receivers; supersonic ultrasound production by beetles; electrical instruments, such as an electrical violin capable of producing many times the volume of an ordinary violin; a survey of prehistorical instruments; and other topics. Interesting discussions on the sense of hearing drawn from a wide variety of works are given for mammals, birds, reptiles, amphibians, fish, and several invertebrate animals.

The book is amply illustrated by diagrams, reproductions of drawings, and photographs. An English translation would be highly desirable in view of its comprehensive and generally popular presentation of the material.

S. PRAGER

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ASTRONOMY FOR TEEN AGERS

Sun, Moon, and Stars. W. T. Skilling and R. S. Richardson. vii + 274 pp. Illus. $2.50. Whittlesey House. New York. 1946.

Sun, Moon, and Stars is a well-arranged presentation of the essential facts of astronomy written, as the authors indicate, for teen-age readers. The book introduces the reader first to the moon as the most conspicuous object in the heavens. The mature reader is somewhat startled to see relatively simple

words spelled out phonetically: Vesuvius (ve-sū′-vĭ-ŭs), occultation (ŏk-ŭl-tā′-shŭn), Colorado (kŏl′ō-rah′dō). One may perhaps wonder at the state of the intelligence of teen agers assumed by the authors. Certainly juvenile, grammar school, or even grade school pupils are well acquainted with the pronunciation of many words in geography. In writing simply it is always difficult not to write down. In general, however, the authors have been successful, and they fortunately avoided most of the subject material that could not be explained adequately to a child. The exposition of the somewhat difficult term "parallax," for example, is well achieved in explaining the method by which astronomers measure the distance to the moon and other inaccessible objects.

Part Two deals with the sun. Careful distinction is made between spectroscope and spectrograph, but juvenile readers may have some difficulty in evaluating the meanings of spectral lines and the account of the Zeeman effect in sunspots without a more complete background of the methods of spectrum analysis than the book contains. Sunspots are also described, and their effect on the earth is briefly mentioned. The authors miss an opportunity to tell radio-minded youths of the disturbances accompanying large sunspots, which may black out long-distance radio communication for hours or days at a time. An elementary introduction to atomic energy is presented in a comparison of the sun to an atomic bomb. Fortunately for the young reader, the authors refrain from any detailed description of the carbon cycle as a source of the sun's energy. With a suitable reference to Dr. Bethe and the statement that "four atoms of hydrogen are changed into one atom of helium and, in the process, 1/140 of the total energy of the hydrogen is set free," the subject is dismissed.

Part Three relates to the planets, their orbits, sizes, possible origin, and physical descriptions. The elementary knowledge of the cause of the seasons and the apparent annual motion of the sun and the motions of the earth are treated here. The discussion of other planets includes some of the best photographs obtainable. It is doubtful, however, that spectrograms will be generally intelligible to the class of readers for whom the book is written.

Part Four is devoted to the stars. This includes simple diagrammatic representation of the constellations, obviously drawn to stimulate familiarity with the heavens. There are simple directions for locating the constellations and there are descriptions of interesting objects such as nebulae, clusters, and dark clouds of the Milky Way.

The book closes with Part Five, which is devoted to astronomers, observatories, and their telescopes. Many of the photographs are excellent, but some definitely are of inferior quality. The book may be commended to juveniles, however, and, it is hoped, may stimulate young readers to take an interest in the fascinating science of astronomy.

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COMMENTS AND CRITICISMS

"Photomicrography"

A recent issue of a popular magazine published an article on "Microphotographs." I wrote to the editors to the effect that I understood that the proper term is "photomicrograph." My explanation was: A microphotograph is a very small photograph of any object. An example is the tiny rodlike lenses that were prevalent during the early gay nineties. By holding this lens very close to the eye, the picture could be discerned—usually an undraped figure. This gadget was frequently mounted transversely through the end of a fancy lead pencil. This, we maintained, was a "microphotograph." On the other hand, we believed that an illustration made of a microscopic object "blown up" to useful size was properly termed a "photomicrograph," i.e., a picture of a tiny thing as opposed to a tiny picture of an ordinary object.

The popular magazine courteously replied, thanking me for inviting their attention to the mistake and politely informing me that I had been equally at fault—that the proper designation could be either "*macrophotograph*" or "photomacrograph."

In this dilemma I turned to Professor Irving Outcalt, the Dean of English and final tribunal of such questions. Professor Outcalt states: "'Photograph' is a recent word in our language, but it has been accepted as a word in good standing. Therefore it should be used as a word, intact. The practice of dividing it as in 'photo-macro-graph' is poor usage. The proper term to designate a photographic illustration of a tiny object is therefore 'Macrophotograph.'"

We therefore courteously suggest that J. V. Butterfield's excellent article in the July SM would more properly have been entitled "Color Macrophotography" and not "Color Photomicrography."—CHAPMAN GRANT.

Science and World Community

The article by Dr. Melvin Rader is for me the center of interest in the June issue of the SM. It echoes the nervousness of so many philosophers, scientists, and other learned men about the danger in which we all stand from the atomic bomb.

He commences by telling us that "all that we cherish may be destroyed because man's capacity to make scientific discoveries outstrips his capacity to control them." He goes on to tell us that "without a different sort of world view than has been prevalent we cannot make the arts of life prevail over the techniques of death." He draws attention to the generally recognized fact that "the old fixed concepts have broken down, and a new world view is emerging."

In the body of the article he points out that the transformations that create the atom out of the primary particles, the molecules out of the atoms, cells out of molecules, and living creatures out of cells stand for different levels of emergence. Also each level above the first represents an envelopment by the level derived from its predecessors. Thus the body envelops the cells, the cells the atoms, and the atoms the primary particles. He stresses the fact that science is finding more and more significance in wholes than in the parts of which they are constituted. They are more, generally far more, than the sum of the parts. To intrude an illustration that occurs to me, the atom is a balance made up of electrons, protons, and the rest of the primary particles. It has functions and potentialities that are quite different from those of the parts. This is sufficiently indicated when we note that its essential feature lies in the fact that it is a balance.

At this point Dr. Rader makes a statement that I will revert to later. It amounts to saying that since mentality has evidently developed long after the early levels of emergence, it is unlikely that all reality is mental. He also rejects the materialistic assumption that all reality is physical—that is to say, contained in sensory experience.

We are left without a clue to what he thinks reality is.

To revert to the article, our author points out that cooperation is quite as important an aspect of biological progress as survival of the fittest. The rule of tooth and claw is modified by many factors other than that of the struggle of the individual to exist. I regret that space forbids me to enlarge on a topic which is admirably dealt with.

So far the world presents the men who dwell in it with hopeful aspects. We may, *pace* the atomic bomb, look forward to a social development of a more benign type than has been known in the past.

Here, however, Dr. Rader introduces his doubts.

Knowledge has become so specialized and so unwieldly that it is hopeless to expect any one man to be able to view it as a whole. A great deal of research is wasted because the records

which deal with it are lost amidst hundreds of other records. The piling up of facts and their classifications defeats itself.

What the world wants is a great effort of synthesis as the result of an education to which no man may now attain. It follows that the intelligent guidance of the world, which can only arise from this supersynthesis, is actually becoming less and less possible with the increase of knowledge.

Dr. Rader gallantly concludes with a refusal to be downhearted. He holds that "it is unlikely that mankind could achieve the magnificent structure of science and yet could so wantonly misdirect it as to destroy the human race."

The article is typical of the current confusion of thought which has followed the crash of the old materialism. That has been sunk without leaving a trace. The universe presents to the modern scientist no vestige of mechanism. But the mechanistic type of thinking dies hard. Dr. Rader is speaking in terms of mechanism when he talks of stages of emergence and of the late "development" of mentality. The Freudian who regards man as a function of his sex furniture talks in terms of mechanism. The Darwinian biologists, who attribute biological progress to natural selection or some other specious concept, are talking in terms of mechanism. None of the people who cling to this kind of thinking appear to realize that they are flouting the well-established, if recent, finding of the physicists to the effect that the universe as known to them shows no trace of mechanism. This finding cannot be evaded by setting up mechanisms that are picked up out of the atmosphere created by the old materialism but have no other basis. What the creators of these quasi mechanisms are doing is to evade recognizing the only entirely objective reality, the only entirely objective fact, known to us. That fact is the certainty which each one of us has in the existence of his own personality. Every other fact, every other kind of experience, frames itself against this background. Further, since men live with and influence one another in ways that are not open to other beings and entities, man's confidence that his own personality is merely one among a great number of similar personalities is only less absolute than his confidence in his own existence. From this commerce of daily life has sprung the whole of knowledge, on its commensurable and incommensurable sides alike. Of course personality is simply a synonym for mentality. It is also a synonym for consciousness, purpose, perception, and indeed for every term that is an aspect of personality. Mentality can be given two meanings. In one it is a statement of the fact that man's every experience occurs within the framework of his personality and has no other claim to be called real. In the other meaning, it is extended to cover every entity in creation. Just as every man recognizes that other men exist with personalities akin to his own, so may he recognize that every entity that exists may in its real aspect be a personality. In this view, not only are the rest of the creatures that we regard as living, personalities, but the inorganic entities also are personalities, despite the fact that they are so far removed from us in form and function that this attribute is not ordinarily recognizable. In this view, the whole universe is a plenum of life, mentality, or personalities. In other words, it is a plenum of facts akin to the most objective fact known to man—the fact of his own existence.

I will not pursue this subject in detail here. I have written a book about it which can be consulted by those who are interested. I may, however, mention for the reassurance of proposed readers that it has been wholeheartedly approved by scientists of the standing of Jeans and Stromberg and that it has aroused the interest of Einstein. The modern scientist recognizes that physical reality is produced by superphysical agencies, which must be so designated because they can never be observed. The cosmos is a plenum of these agencies. When they operate to bombard our nerve terminals with photons of the frequencies that those terminals are constructed to accept, and when the bombardment takes place in mass sufficient to overpass the threshold of sensation, the process by some magic is translated into a sensation. But the frequencies that can be accepted are a minute fraction of the frequencies that exist; and this circumstance shows that human knowledge is confined to a tiny fringe of the total of cosmic reality. It is for this reason that the modern scientist no longer considers that he can explain anything. His function is confined to using the facts revealed by sensory experience and basing on them formulae of prediction. He recognizes that these formulae have no pretension to explain anything.

Thus modern science recognizes its own limitations. Beyond those limitations lies a vast plenum of activities which may be due to personalities, though modern scientists as a class avoid making this admission. It would be tantamount to an admission that the reality of the cosmos is spiritual, and, for people who have only very recently disengaged themselves from material prepossessions, this hesitation is understandable. I gather, however, that the scientific convenience of a vast unification, such

as that imposed by the acceptance of the vital interpretation, is gradually being recognized. There is absolutely no *scientific* objection to its acceptance. Every religion and every perception of the noumenal springs from an intuitive knowledge of the spiritual quality of the background of all existence. It is from these sources, and not from the commensurable type of experience, that the almost universal conviction of the value of human life and the importance of human conduct arises. This conviction is the only permanent defense against the atomic bomb and the rest of the terrifying discoveries of science.

I would conclude a letter which is far longer than I ever intended it to be by inviting Dr. Rader and the rest of our anxious intellectuals to study the philosophy of Leibnitz. He was a contemporary of Newton and shares with him the credit for inventing the differential calculus. Consequently he lived in an age in which matter dominated the speculations of science. In that day the atom was no more than an intellectual abstraction. Dalton, who made it the basis of a new chemistry, did not write till about a hundred years later.

And yet, in these surroundings, and with an extensive knowledge of physics of the Newtonian type, he gave to the world a philosophy identical with that which I have outlined in this letter. He called the personalities monads. He considered that every entity in the universe that is not a mere aggregate is a monad. For him the reality of every entity lies in this fact. His monads are simple, percipient, self-acting beings, the constituent elements of all entities. They are the very elements of nature. They do not have parts, shapes, nor extension. They are metaphysical points or, rather, spiritual beings, whose very nature is to act. Every monad mirrors the universe in its own way. Today we would say that it mirrors the universe in terms of its own sensory furniture. This circumstance leads to a fundamental harmony of perception based on diversity. This is the philosopher's celebrated "pre-established harmony" of the universe. Monads manifest themselves as aggregates or extended masses. There are no such things as absolute vacua, empty space, indivisible material atoms. The true nature of substance is energy. There are ruling monads—ruling because they seem to rule. Here Leibnitz gives the human body as an example in which the ruling monad, which is the soul, seems to coordinate the multitude of monads which constitute every particle of the body. He tells us that space and time are merely relative. We must here recognize that Leibnitz has foreseen the entire picture of the universe as it presents itself to the modern scientist under the aspects of relativity and quantic physics. That he was able to do so some two hundred years before these types of physics existed is simply miraculous. And yet it is all there. Explain it who can.

I know of no work on Leibnitz that presents it in terms which bring out his exceedingly modern significance. The latest that I know was written by Bertrand Russell in 1900. It is a most learned and able work but misses a significance that was not discernible at that date. The recent edition of the *Encyclopaedia Brittannica* has, however, a very fine article on Leibnitz, which is the source from which I have taken my brief notes on his philosophy.—SIR RICHARD TUTE.

The Biological Basis of Imagination

Congratulations and commendations on "The Biological Basis of Imagination" article in the June SCIENTIFIC MONTHLY. Dr. Gerard has performed a notable public service in assembling the facts which are presented in this article. Every student and thinker could well profit by reading it.

My co-worker, Professor Harry La Verne Twining, was particularly enthusiastic over the presentation and declared that it bears out his own experience in solving problems relating to space and atomic energy.—FRANKLIN LLEWIS.

Lady of the Lagoon

Up from the sea that covered her,
Blown full-fledged with the waning moon;
Rainbowed, the head and neck of her;
Bombed, our Lady of the Lagoon.

No atoll ever was so struck;
Nor sea ever surged by typhoon;
No hair ever singed by such ruck:
Gone—the Lady of the Lagoon!

HOWARD S. ANDERS, M.D.

The foregoing lines were written by Dr. Anders after he saw the now well-known news-photograph of the second Bikini test. Here, thought Dr. Anders, was not the "Lady of the Lake" but the Lady of the Lagoon. In an attached note he added: "Can you imagine an M.D. of 56 years of practice, and pioneering and fighting in the fields of preventive medicine, public health, and municipal sanitation falling for the eight lines that this note introduces?"—Ed.

THE BROWNSTONE TOWER

This may be the last editorial I shall write in the Tower of the Smithsonian, for the A.A.A.S. building on Scott Circle is nearly ready for occupancy. Although I did my best in the SM to stimulate contributions to the Building Fund and will continue to do so for the sake of the A.A.A.S., I regret my impending departure from the Brownstone Tower. One could not have a more inspiring office than mine for editorial work. Situated in the flag tower of a building so famous that it is now the subject of a commemorative postage stamp, my office is comfortable and secluded, yet looks out upon some of the shrines of our country. But my attachment to my office does not rest entirely on its situation. It is full of happy associations: of three years of labor with loyal assistants, of pleasant acquaintanceship with members of the Smithsonian staff, and of successful struggle to overcome the effects of illness and death.

My new office at 1515 Massachusetts Ave., if lacking in glamor, has its compensations. It is situated on the second floor of the house shown on page 556 of the June SM. Having an ivy-covered bay window facing Massachusetts Ave., it might pass as a tower room if the rest of the house is disregarded. This room is about twice the size of my present office. It has a fireplace, which, whether functional or not, will add to the possibilities of furnishing the room attractively. I shall occupy this room alone, for my assistant will have a smaller adjacent room over the front entrance. Thus we should be able to work more efficiently than we can now. Our move to the new building will be marked by the elimination of the cut of the Brownstone Tower from this page. But the title of this column will be retained in memory of the owls.

Everyone must know that August 10, 1946, was the centennial of the founding of the Smithsonian Institution. The A.A.A.S. observed the occasion by devoting the August 9 issue of *Science* to a review of the history and accomplishments of the Smithsonian. To maintain interest in the centennial we decided to defer the SM's tribute until the November issue. That issue, we hope, will be devoted largely or entirely to contributions from members of the Smithsonian staff.

In the present issue we offer an unusual story on which some editorial comment may be desirable. I refer to Dr. Shimkin's experiences in bringing first aid to the newly liberated victims of a German concentration camp. It is not science. It is not even about science. It is a grim story of horror and anger and compassion told by a scientist who is also a human being. We accepted it to remind our readers that science is merely a refinement of civilization. Without a core of basic virtues centered in love, civilization is a hollow shell that scientific knowledge cannot save. There *is* truth that does not have to be confirmed by repeated measurements. "Charity never faileth: . . . ; whether there be knowledge, it shall vanish away." One need not take refuge in the supernatural to know the reality and importance of Christian virtues. To add scientific knowledge to the practice of these virtues is to live happily and usefully. To get knowledge without humanity is insane.

Consider, by contrast, the international good will inherent in the present article by R. L. Steyaert on the Belgian Congo. Dr. Steyaert, probably the only member of the A.A.A.S. in central Africa, sent us his manuscript as an expression of appreciation for the pleasure he has derived from the SM. Let us hope that scientists throughout the world will follow Dr. Steyaert's example.

F. L. CAMPBELL